

From a Healthy Diet to Pathology: Exploring the Complexity of Orthorexia Nervosa.

Elina MITROFANOVA

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Abstract

Orthorexia Nervosa (ON) is described as a pathological obsession with ‘healthy’ eating. Its status as a clinical diagnosis is yet to be established with no consensus on diagnostic features or tools. This thesis’ aim was to explore ON and understand its contributing dimensions. Results of this work, which included seven studies, highlight discrepancies with the existing diagnostic criteria and present a new independent measure of ON. Qualitative explorations of existing tool of ON (ORTO-15) (chapter 2) and in-depth interviews (chapter 3) suggest a great variability in reasons for adhering to the diet perceived as healthy. Commonalities cited included the desire to improve one’s appearance and the desire for control over one’s dietary intake. Unlike previous research, this work suggests considering appearance as important contributor to orthorexic tendencies. Exploration of nutritional composition of dietary intakes (chapter 3) further suggested that ON, unlike established eating disorders, is not characterised by malnutrition or any one pattern of nutritional deficiency. Individuals that claim their diets to be healthy demonstrated deficiency of several nutrients. The concept of a “healthy” diet is an individually prescribed concept that was not based on nutritional guidelines. Results of nutritional and qualitative explorations informed the development of an independent measure of ON (chapter 4). Screening Tool for Orthorexia Nervosa (STONE) and its short version (STONE-S) consider ON to comprise three dimensions: desire to enhance/maintain one’s appearance, pure diet, and control over food consumption and preparation. STONE-S was a stronger tool able to differentiate ON from eating disorders, religious diets, restricted eating cause by medical conditions, and no restriction groups. Overall, the new measure could be a good starting point for exploring ON, and by shifting to a qualitative and nutritional

perspectives, this thesis paints a more accurate picture of the features of this complex condition.

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Chapter 1. Introduction and a review of the literature on Orthorexia Nervosa.

1.1 Introduction

Eating behaviour has been the focus of debates in public health and popular media for many decades. At one end of the spectrum of these debates is the global “war on obesity” while the opposite extreme is preoccupied with the rising prevalence of eating disorders. Both extremes describe a dysfunctional relationship between an individual and food to some extent and a great deal of efforts, be they nutritional or psychological, for both conditions are attempting to address the issues related to restraint of food consumption. Historically, dietary restraint and lack thereof were rooted in religion and folktales depicting either spirituality related to self-starvation and religious fasting or overeating and giving away food to the less fortunate as a mark of privilege (Bynum, 1985). Thus, food always represented not only a material necessity for survival but was intertwined with societal values and moral virtues.

Dietary restraint became more widespread and acquired a new meaning in the 20th century with developments in the fashion industry that emphasised women’s freedom from corsets (Ogden, 2018). On one hand this change in dress code brought freedom of movement and increased participation of women in the workforce, on the other, however, without the support of the corset, only women whose body shape did not need the support naturally were seen as acceptable (Ogden, 2018). Restraining one’s food intake became a solution in the striving for a permanent change of body shape, which allowed one to fit into the new socially acceptable body ideal. This new body ideal continued to evolve into an increasingly slimmer body shape, which came to represent the image of an emotionally stable person possessing willpower and control of her/his diet and life. This ideal was further reinforced by the fashion

industry portraying thin models on the runways and in magazines and the dieting industry providing resources and reassurance that weight loss and change in body size were, in fact, achievable. The situation would have evolved further along this path had it not been for the incident that revealed the truth about the struggles of those involved in the fashion industry to maintain the ideal they project to the world. In 2006, a model collapsed while participating in “Fashion Week” and later died in a hospital of heart failure caused by anorexia nervosa (AN) (Condrón, 2006). In response to the growing public concern after the incident, several countries introduced a ban on employing individuals with a body mass index (BMI) lower than 18kg/m^2 (Moore & Malik, 2006), in an attempt to tackle eating disorders not just in participants of the industry, but also in recognition of the industry’s impact on the body image aspirations of the general population. These events set a new trend that fuelled the convictions of a growing community of individuals concerned with a healthier lifestyle.

While the World Health Organisation (WHO) “recommends eating lots of fruits and vegetables, reducing fat, sugar and salt intake and exercising” to ensure a healthy lifestyle (WHO, n.d.), the concept of “healthy” diet may vary between individuals and often does not rely on recommendations provided by the government. Some scholars (e.g. Nicolosi, 2007) suggest that the drive for “healthy” nutrition has become a reflection of the value society places on individualism. Increased desire to control one’s diet results from two simultaneous processes. In modern society, the body (and health) is viewed as the sole responsibility of the individual, while at the same time the majority of the population does not know the origin of the food they consume due to the modernised processes of food production (Nicolosi, 2007). In addition, social media networks, bookstores, and the internet

provide an abundance of information on what “healthy” should be, resulting in a growing number of individuals changing their personal lifestyle in accordance with an allegedly healthy one. Typically, these health promoting behaviours are regular exercise and healthy eating (Wright et al., 2006). Considering the links between diet and health (e.g. Akesson et al., 2013; Barak & Fridman, 2017; Sami et al., 2017), the goal to achieve a better nutritional intake may be a step in the right direction. However, in some cases, a desire for a healthier diet can turn problematic if taken to the extreme.

A new condition was first defined by Steven Bratman in his essay in 1997. His definition was based on observations of his patients in his alternative medicine practice. The term *orthorexia nervosa* (ON) was used to describe a “fixation on eating proper food” (Bratman, 1997). Research on ON in the last two decades has evolved and several attempts have been made to define and establish diagnostic criteria for this condition.

1.2 Literature review

Definition and diagnostic criteria. Despite the progress in the field of ON, a universally agreed upon definition of this condition is yet to be reached. Cena et al. (2019) conducted a literature review attempting to assess the different definitions used by researchers when studying ON. Interestingly, this review reports that not all studies concerned with ON provided a definition for the condition. The most common words used to describe ON were obsession, fixation, and preoccupation (Cena et al., 2019). All three terms describe an excessive attention to food, which takes over one’s cognitions and leads to behaviour sustaining this fixation.

To further define characteristics of ON, several research teams have proposed diagnostic criteria. The first criteria to appear in referenced literature were developed from a case study by Moroze et al. (2015) and focused on describing ON's obsessional features. Later Barthels et al. (2015) proposed another set suggesting negative affect caused by the preoccupation with "healthy" nutrition as an important contributing dimension. Finally, Dunn and Bratman (2016) added a clinically impairing component recognising possible weight loss and impairment of social functioning in addition to the already existing features of preoccupation and obsession with healthy eating. Table 1.1 presents the diagnostic criteria proposed by Dunn and Bratman (2016).

Table 1.1.

Diagnostic criteria for ON proposed by Dunn and Bratman (2016).

Criteria	Definition
Criterion A	<p>Obsessive focus on “healthy” eating, as defined by a dietary theory or set of beliefs whose specific details may vary; marked by exaggerated emotional distress in relationship to food choices perceived as unhealthy; weight loss may ensue as a result of dietary choices, but this is not the primary goal. As evidenced by the following:</p> <p>A1: Compulsive behaviour and/or mental preoccupation regarding affirmative and restrictive dietary practices believed by the individual to promote optimum health.</p> <p>A2: Violation of self-imposed dietary rules causes exaggerated fear of disease, sense of personal impurity and/or negative physical sensations, accompanied by anxiety and shame.</p> <p>A3: Dietary restrictions escalate over time and may come to include elimination of entire food groups and involve progressively more frequent and/or severe “cleanses” (partial fasts) regarded as purifying or detoxifying. This escalation commonly leads to weight loss, but the desire to lose weight is absent, hidden or subordinated to ideation about healthy eating.</p>
Criterion B	<p>The compulsive behaviour and mental preoccupation becomes clinically impairing by any of the following:</p> <p>B1: Malnutrition, severe weight loss or other medical complications from restricted diet.</p> <p>B2: Intrapersonal distress or impairment of social, academic or vocational functioning secondary to beliefs or behaviours about healthy diet.</p> <p>B3: Positive body image, self-worth, identity and/or satisfaction excessively dependent on compliance with self-defined “healthy” eating behaviour.</p>

Other features that were not listed in the diagnostic criteria include avoidance of genetically modified foods (GMO), foods believed to contain pesticides, foods with added sugar and salt, non-organic foods, foods high in fat, grains, and foods individuals allege allergies to (Brytek-Matera, 2012). Despite the existing attempts to establish diagnostic criteria, the debates on whether ON can be considered a stand-alone disorder are ongoing.

Diagnostic tools for ON. One major deterrent in all research conducted on ON is a lack of accepted diagnostic tools. Not being able to accurately identify affected individuals will always present a challenge to all studies investigating this phenomenon. Several questionnaires have been developed over the years in an attempt to develop a diagnostic tool. These are discussed in turn below.

Bratman Orthorexia Scale (BOT)

The first version contained 6 statements with yes/no responses and was published in Bratman's book *Health Food Junkies* (2000). This short scale was developed as an informal measure for people overly concerned with healthy diet and was later expanded to include ten statements by Bratman and Knight in 2000. No validating procedures were followed in the development of this scale and no cut-off point exists for it. This fact, however, did not discourage its use in academic research (e.g. Bundros et al., 2016). Bundros et al. (2016) found that scores on BOT were significantly associated with Eating Attitude Test (EAT-26), Body Dysmorphic Disorder Questionnaire (BDDQ) and the Obsessive-Compulsive Inventory (OCI-R). The scale has been translated into German and Swedish (Eriksson et al., 2008; Kinzl et al., 2006). The BOT has been criticised for a lack of appropriate psychometric

procedures in its development and for a lack of reporting on its validity in the studies using this scale (Missbach et al., 2016). The use of this instrument may be contributing to the confusion regarding ON's status as a valid eating disorder. However, a recent study comparing the four existing measures of ON found BOT to be an internally reliable self-report measure which is correlated with two other existing measures of ON (EHQ and DOS) providing evidence for the convergent validity of the instrument (Meule et al., 2020). Meule et al (2020) recommend its use over the more popular scale ORTO-15.

ORTO-15

This questionnaire was developed by an Italian research team and was based on items from the BOT (Donini et al., 2005). The ORTO-15 includes six BOT items and nine additional items intended to reflect obsessive-compulsive traits. Responses are based on a 4-point Likert scale (always, often, sometimes, never) and the cut-off score was set at 40 with scores below indicating the presence of ON. To date, ORTO-15 remains the most frequently used questionnaire in ON studies (Valente et al., 2019). Since its publication, several versions have emerged for use in other languages. Some of them were left unchanged and simply translated (Asil & Surucuoglu, 2015; Pontes et al., 2014; Stochel et al., 2015; Jerez et al., 2015), while others were modified based on the assumption that exclusion of some items would make the scale better suited for the language of the population under investigation (Arusoglu et al., 2008; Brytek-Matera et al., 2014; Missbach et al., 2015; Varga et al., 2014). Every time ORTO-15 was adapted, different items were dropped from the original, for example, the Turkish version had items 1, 2, 9, and 15 excluded (Arusoglu et al., 2008), while Hungarian researchers chose to discard items 5, 6, 8, and 14 (Varga et al., 2014). Exclusion of certain items from ORTO-15 was allegedly

done to increase its reliability and validity. While it is possible that Hungarian and Turkish adaptations excluded different items due to cultural differences, it is also possible that ORTO-15 was not a reliable measure to start with.

Originally, ORTO-15 was meant to measure three dimensions of ON: cognitive-rational, clinical, and emotional. However, only one study, to date, attempted to confirm the factor structure of the scale. Moller et al. (2019) examined 15, 11 and 9 items versions of ORTO-15. Results indicate that none of the versions demonstrated an acceptable model. Researchers suggested that the only version of ORTO-15 with a stable factor structure was a 7-item single factor.

Recently, studies employing ORTO-15 started to recognise its use as one of the limitations to research (e.g. Plitcha & Jezewska-Zychowicz, 2020). A recent study suggested that the problem with ORTO-15 might be related to the scoring of the scale proposed by the original authors. Despite several studies' attempts and consistent results which critique ORTO-15's internal structure, no study to date has attempted to identify the exact issues with the scale's items.

Eating Habits Questionnaire (EHQ)

EHQ was developed in the USA by Gleaves et al. (2013) and was based on the analysis of the Bratman and Knight's case studies. The questionnaire contains 21 items with responses ranging from "1=False, not at all true" to "4=Very true".

Authors suggest three factor structure of the scale: problems associated with healthy eating, knowledge of healthy eating, and feeling positively about healthy eating (Gleaves et al., 2013). However, later studies' investigations into the structure of this scale are inconsistent. For example, Mohamed Halim et al. (2020) investigations of EHQ presented a four-factor structure of the ON: healthy eating cognitions, dietary

restriction, diet superiority, and social impairment. The authors concluded that “The EHQ appears to be a better measure of normal healthy eating habits, rather than orthorexic tendencies.” (Mohamed Halim et al., 2020, p. 7). Another study has identified three items that loaded on to the EHQ-Behaviours subscale instead of the EHQ-Problems subscale (suggested by the original authors of the questionnaire) (Oberle et al., 2017). In addition, a possible limitation of this questionnaire is that it does not include items reflecting the negative affect possibly associated with ON symptoms (e.g. shame, guilt, self-punishment) that individuals experience when their self-imposed dietary restrictions are violated (Roncero et al., 2017). The EHQ questionnaire might be a better measure than ORTO-15 but its internal structure needs further analysis. Interestingly, despite the existence of EHQ since 2013, most publications on ON still use ORTO-15.

Dusseldorf Orthorexia Scale (DOS)

DOS was developed by Barthels et al. (2015) in Germany. The questionnaire consists of ten statements with possible responses ranging from “1=This does not apply to me” to “4=This applies to me”. The suggested cut-off score is 30 with scores between 25 and 29 indicating being at risk for ON. The scale was constructed and validated in German and was subsequently translated and validated in English (Chard et al., 2019). Studies investigating the internal structure of DOS present inconsistent results. While confirmatory factor analysis of the English version revealed a poorly fitted one-factor model (Chard et al., 2019), Meule et al. (2020) confirmed a unidimensional structure of DOS. Recently the scale was translated and validated in a Chinese sample (He et al., 2019). This version of the scale demonstrated that a one-factor model did not fit the data very well. Instead, exploratory factor analysis revealed a three-factor structure: “obsession in healthy

food”, “adherence to nutrition rules”, and “emotional symptoms” (He et al., 2019). In addition, the scale has been criticised for its inability to differentiate between patients suffering from AN and those displaying orthorexic tendencies (Valente et al., 2019). The scale is relatively new and needs further development.

Teruel Orthorexia Scale (TOS)

The scale was developed and validated in Spain by Barrada and Roncero (2018). The scale assumes a bi-dimensional structure of ON (i.e. healthy orthorexia and orthorexia nervosa). Healthy orthorexia implies an interest in healthy eating while orthorexia nervosa, in this interpretation, is the pathological preoccupation with food. The structure of the scale was later confirmed by Barthels et al. (2019) and revealed that “orthorexia nervosa” dimension of the scale was positively associated with negative affect whereas “healthy orthorexia” was positively associated with positive affect, which further supports the two-factor structure of the scale and suggests that a desire to eat a healthier diet should be differentiated from pathology. Interestingly, a study investigating motives for food choices using TOS revealed that the “orthorexia nervosa” dimension was motivated by weight control while for “healthy orthorexia” it was the perceived health benefits of the food (Depa et al., 2019). TOS is the newest instrument and no criticism, to date, was identified for this tool. However, ON is a complex phenomenon that is very likely to include more than healthy and pathological dimensions that should not be overlooked.

Considering the increasing number of new measures, it is still unclear if all measures do in fact measure the same construct. All measures were developed using different variations of the conceptualisation of ON (Valente et al., 2019). In addition, no scale used qualitative methodology in its development. This step could contribute

to acquiring in-depth information about ON and help to develop diagnostic criteria and tools.

Prevalence. Academic literature on ON is rife with studies attempting to examine its prevalence among various groups that are either considered vulnerable to ON (e.g. dancers, yoga practitioners) or who represent an opportunistic sample (e.g. university students). Unlike established eating disorders, prevalence rates for ON vary greatly from less than 1% in a sample of American University students (Dunn et al., 2017) to 86% among Spanish yoga practitioners (Herranz Valera et al., 2014). Interestingly, Dunn et al. (2017) reported 71% prevalence rate measured by ORTO-15 (Donini et al., 2005) questionnaire. However, when considering whether participants' diet caused impairment in everyday functioning and medical problems, prevalence rate decreased to less than 1% in the sample. This might be an indication of the poor performance of the questionnaire used in this study. The scale was not able to distinguish between individuals that might have dietary restrictions and are trying to eat healthier and those that present a pathological dimension of healthful eating. Studies investigating ON prevalence among individuals studying on health-related programs and those involved in health-related occupations report high prevalence rates ranging from 41.9% to 86% (Asil & Surucuoglu, 2015; Herranz Valera et al., 2014; Tremelling et al., 2017). However, no difference in ON prevalence was found when studies used control groups (Almeida et al., 2018; Clifford & Blyth, 2018; Missbach et al., 2015; Sanlier et al., 2016). For example, students in university sports teams and non-athlete students demonstrated a 76% ON prevalence rate with no difference between the two groups (Clifford & Blyth, 2018). These numbers look alarmingly high in comparison to the prevalence of eating disorders that are accepted by the DSM-V (American Psychiatric Association

(APA), 2013) whose prevalence in the general population is no higher than 2% (Smink et al., 2012). This might be due to the fact that investigations into ON prevalence were and continue to be carried out before either universally recognised diagnostic criteria or diagnostic tools are developed.

ON and its link to obsessive-compulsive disorder and other eating disorders. In a review by Koven and Abry (2015), researchers proposed that symptoms of orthorexia echo symptoms of both anorexia nervosa and obsessive-compulsive disorder (OCD). Earlier research based on the assumption that ON symptoms do not involve a desire to lose weight, which is present in AN and bulimia, suggested that ON has more in common with OCD than with eating disorders (Brytek-Matera, 2012). In fact, the lack of fear of weight gain was suggested to be the very feature that separates ON from established eating disorders and identifies this condition as an eating pathology in its own right (Dunn & Bratman, 2016). However, subsequent studies highlighted that this was not always the case, and suggested that the desire for weight control was present among individuals self-identifying as having ON (e.g. Valente et al., 2020). For example, a study investigating the bidimensional structure of this condition suggested the presence of “healthy orthorexia” and “orthorexia nervosa” as two distinct concepts and reported that the main motive for dietary restriction in “orthorexia nervosa” (pathological dimension) is weight management (Depa et al., 2019). Researchers, therefore, suggested that ON is a socially acceptable presentation of an existing eating disorder.

Aside from the desire for weight control, based on the review of the literature, Cena et al. (2019) proposed several other similarities between ON and established eating disorders. Like individuals suffering from eating disorders,

individuals with possible ON are preoccupied with food and thoughts about food dominate one's life; self-esteem and identity relying on the ability to avoid straying away from the diet of choice. Both groups structure their lifestyles around their eating behaviour and display such personality traits as rigidity and perfectionism. The consequences are social isolation, malnutrition, and somatic problems. However, very similar characteristics were suggested to account for similarities between OCD and ON, namely rigidity, perfectionism, social isolation, and obsessive-compulsive behaviours (Cena et al., 2019). These similarities are not surprising, since the co-occurrence of eating and obsessive-compulsive disorders is well documented within the research literature. One explanation for this co-occurrence suggests that individuals' personality trait perfectionism accounts for vulnerability to both conditions (Altman & Shankman, 2009; Bulik et al., 2003). Furthermore, a recent study by Bartel et al. (2020) suggested that when statistically controlling for eating disorders' symptoms, association between OCD and ON was absent. The authors propose that the associations between OCD and ON observed in earlier studies result from the comorbidity of OCD and eating disorders in samples placing ON in the eating disorders spectrum. The relationship between ON, eating disorders, and OCD are complex and discussions in research literature on the exact nature of this association are ongoing.

Interestingly, ON symptoms tend to increase after treatment for eating disorders (AN) among the clinical population (Segura-Garcia et al., 2015). From this perspective, ON might represent a shift from excessive attention to the quantity of food consumed to its quality. It is yet to be known if this shift could be considered a therapeutic improvement. However, it suggests a similarity in cognitive styles underlying both conditions where the desire to control one's dietary intake remains,

but the focus is shifted from quantity to quality. The debate over whether ON is an actual eating disorder or a combination of features from other recognised conditions has yet to reach its conclusion.

Age and gender. Determining which gender and age group are more susceptible to ON is often a common concern for the existing research. To date, however, the findings are inconsistent regarding the role of age and gender as risk factors for ON. Some studies suggest that ON is more prevalent among younger participants (Dell’Osso et al., 2016; Fidan et al., 2010; Livazovic & Mudrinic, 2016), while others demonstrate the trend to be in the opposite direction (Varga et al., 2014). More recent findings indicate no significant relationship between age and ON (Depa et al., 2017; Reynolds, 2018). There is no consistency in the available literature with most studies focusing their research on younger populations. More studies investigating this phenomenon among older adults are needed to draw any conclusion whether ON can be considered a chronic condition affecting all ages or if this condition is only experienced by populations of a certain age.

A similar inconsistency in research literature exists when considering the relationship between ON and gender. Some studies report higher ON prevalence among female participants (Missbach et al., 2015; Roncero et al., 2017; Sanlier et al., 2016), while other findings suggest higher prevalence rates among men (Fidan et al., 2010; Malmberg et al., 2017). The majority of studies, however, report no difference between men and women in ON prevalence rates (Barnes & Caltabiano, 2017; Clifford & Blyth, 2018; Depa et al., 2017; Dunn et al., 2017; Grammatikopoulou et al., 2018; Herranza Valera et al., 2014; Reynolds, 2018). In sum, there is no agreement on whether ON prevalence varies between genders (McComb & Mills, 2019).

Personality. An increasing number of studies have started reporting on the relationship between ON and particular personality traits. Higher levels of narcissism (Oberle et al., 2017), perfectionism (Barrada & Roncero, 2018; Oberle et al., 2017; Parra-Fernandez et al., 2018), and neuroticism (Oberle et al., 2017) were associated with an increase in orthorexic tendencies. Interestingly, the traits reported for the ON sample are similar to those displayed by individuals with AN and OCD (Kiss-Leizer & Rigó, 2019). In particular, when assessed by Temperament and Character Inventory (TCI) (Cloninger et al., 1994), high harm avoidance, low self-directedness, and high transcendence were the traits displayed by participants of Kiss-Leizer's and Rigó's (2019) study. High harm avoidance indicates a pessimistic outlook on the future and shyness in front of strangers, low self-directedness indicates low self-esteem, uncertainty around identity and assigning blame to others (Cloninger et al., 1994). High transcendence is related to the spirituality assigned to restricting one's dietary intake (Kiss-Leizer & Rigó, 2019). The research was extended in a multicultural study involving Polish, Italian and Spanish university students. Using the same questionnaire students were more likely to present orthorexic tendencies and have a low score on persistence subscale of the TCI (Gramaglia et al., 2019). Researchers explain that low persistence in this context means that individuals might be unable to utilise and adopt appropriate coping strategies in everyday life when faced with harmful events and attempt at "pure" diet is therefore a compensatory mechanism aimed at establishing a sense of being in control (Gramaglia et al., 2019). Studies examining personality traits among those displaying orthorexic tendencies have only started to emerge. One limitation all these studies tend to present concerns the measurement scale used in the research. Without valid diagnostic tools, the results of these studies have to be interpreted with caution.

Body image. The role of body image disturbances in the development and maintenance of recognised eating disorders is well explored (Cash & Deagle, 1997), with both negative body image and internalisation of a thin body ideal considered as important features (Keele et al., 2005). For ON, however, this link remains unclear. Diagnostic criteria proposed by Dunn and Bratman (2016), mentioned positive body image dependent on one's ability to adhere to the "healthy" diet as one of the features of ON while at the same time earlier literature proposed that body image concerns and desire to lose weight are not relevant to individuals with orthorexic tendencies (Bratman & Knight, 2000). Studies investigating this link suggest that fear of becoming overweight and concern for one's appearance might represent hidden motives for adherence to a "healthy" diet (Barnes & Caltabiano, 2017). However, one factor might have had an influence on the results. When considering that individuals displaying orthorexic tendencies are known to be preoccupied with health as a general topic, knowledge of the health issues associated with a high BMI might be translated into the fear of becoming overweight and therefore suffering negative consequences to one's health. Preoccupation with appearance in ON might therefore be a reflection of preoccupation with health. In fact, a qualitative study exploring ON found that one of the main themes reflecting experiences of individuals self-identifying as orthorexic was the fear of chronic health conditions (Valente et al., 2020). To date, it is unclear whether orthorexic tendencies are motivated by striving for a particular body shape alone or by the association the body shape represents for health.

Vegetarianism and veganism. Vegetarianism and veganism have become increasingly popular in recent years. Motives for following these diets vary and include ethical, philosophical (e.g. Buddhism), ecological reasons, preference for

taste, health concerns, financial, familial influences, concerns about the use of antibiotics and growth hormones in meat industry, and fear of contracting disease from certain foods (e.g. salmonella) (Phillips, 2005). Some studies investigating the prevalence of ON among vegetarians suggest that this population is at greater risk of ON compared to omnivores (Brytek-Matera et al., 2019), while others find the vegetarian diet to be unrelated to ON (Çiçekoğlu & Tunçay, 2018). It is worth noting that orthorexic tendencies among vegetarians and vegans might not be related to the diet per se, but are moderated by the reasons individuals cite for following vegetarian/vegan diet. Individuals that chose vegetarianism and veganism for health rather than ethical reasons seem to be more likely to develop orthorexic tendencies (Brytek-Matera et al., 2019). However, vegan diet involves exclusion of all animal products and as a result possibly requires stricter monitoring and control over foods consumed which bears similarity to orthorexic tendencies and might account for higher ON rates among this population. Vegan participants in this study scored significantly higher than vegetarians and those that do not follow any diet on knowledge of healthy eating subscale of the Eating Habits Questionnaire (EHQ) (Gleaves et al., 2013).

Motivations for following vegetarian/vegan diets, whether for ethical or health reasons, have a common underlying factor. In both cases one must exercise a cognitive restraint to adhere to the diet of choice. Brytek-Matera et al. (2019) identified cognitive restraint to be a predictive factor of orthorexic tendencies among individuals on a meat-free diet. Researchers suggested that cognitive restraint of food intake starting as an innocent desire to eat a healthier diet or to exclude meat for ethical reasons has the potential to develop into increasingly restrictive dieting practices. In addition, individuals on special diets tend to report significantly more

current and past eating disorders compared to those who are not following any diet (Barnett et al., 2016). Even though vegetarianism/veganism cannot at this point be considered a predictive factor in the development of ON tendencies, results of the studies above indicate that having these dietary restrictions might present a risk factor.

Physical exercise and ON. If one were to draw a parallel between ON and commonly recognised eating disorders, one would notice that excessive or compulsive exercise is frequently featured in the literature as an important component in the development and maintenance of eating disorder variants (Kolnes, 2016). Exercise has been associated with earlier onset, greater variety of symptoms, higher persistence of eating disorders, and to personality traits such as anxiety, perfectionism, and obsessions (Schroff et al., 2006). Furthermore, a qualitative exploration of the role of exercise among women diagnosed with AN suggests that even though it is perceived as functional in terms of strengthening of sense of self and identity, emotion, distraction and in maintaining a sense of structure and control, it also generates feelings of lacking control (“compulsion to exercise stronger than reason”), and negatively interferes with people’s social lives (Kolnes, 2016). In ON literature, however, in-depth investigations of the role of physical exercise are lacking. Most research tends to assess ON prevalence in already physically active populations (e.g. athletes, dancers, university sport teams). Consensus from these studies is that exercise engagement is positively associated with an increased risk for ON (Segura-Garcia et al., 2012; Varga et al., 2014; Brytek-Matera et al., 2015). Also, the more frequently one exercises the greater the risk for ON (Clifford & Blyth, 2018; Oberle et al., 2018). Findings of these studies are observational in nature and provide a snapshot view of the relationship between ON and physical

exercise. No studies, to date, attempted to explore the moderating role of physical activity in ON.

Nutrition. To date, academic knowledge of dietary patterns of individuals displaying orthorexic tendencies is almost non-existent. Grammatikopoulou et al. (2018) attempted to measure dietary intake of students studying nutrition via a 3-day food diary. The study reported lower energy and saturated fatty acids' intake but failed to provide any information on the presence or absence of other macro- and micro-nutrients in individuals' diet. One other study asked its participants to report the number of servings of fruits and vegetables, snacks, desserts, protein-containing foods, dairy, and grains/starches they consumed on a typical day (Zickgraf et al., 2019). Interestingly, individuals' daily dietary intake in this study was characterised on one hand by a large proportion of fruit and vegetables relative to other food groups and a high proportion of snacks and desserts on the other. However, this study also provides no information on individual nutrient intake. One of the suggested diagnostic features of ON is malnutrition resulting from excluding increasingly more food groups from one's diet in the striving for a "pure" or "healthy" diet and consequently body. No studies, so far, considered assessing whether ON does in fact cause malnutrition in affected individuals or whether there is a pattern of nutrient deficiency in ON diets, which warrants further investigation into this issue.

Several gaps in the academic understanding of ON were identified when reviewing the published literature. First, several sets of diagnostic criteria for ON were proposed, but consensus is yet to be reached. A step in this direction should involve exploring ON using qualitative methodology. Qualitative explorations of ON have only started to emerge. Engaging with individuals experiencing possible ON

could help clarify the diagnostic criteria and inform development of a diagnostic tool. Second, data on dietary intakes of individuals exhibiting orthorexic tendencies is lacking. Exploring this aspect of ON using nutritional methodology could help in establishing the relevance of some of the proposed diagnostic criteria. Finally, the diagnostic tool used in most studies on ON (ORTO-15) has been criticised for its poor quality. Despite the emergence of new measures, ORTO-15, or its variations, are extensively used in research even to this day which warrants further investigation into this scale.

1.3 Aims.

In view of gaps in research discussed above, this thesis's aims are the following: (1) investigate the kinds of difficulties people experience when completing the ORTO-15, explore people's thought processes about the ORTO-15 items and ascertain any potential discrepancies between what signs of ON actually mean to the participants; (2) measure actual dietary intakes of those displaying signs of ON; (3) investigate people's relationship with their food choices and explore reasons for adherence to the "healthy" diet; (4) design and validate a new measure of ON.

1.4 Research Plan

This thesis was designed to consist of a series of independent studies forming three empirical chapters. Chapter 2 includes the study exploring perceptions of ORTO-15 items and was modelled after Kaklamanou et al. (2013) "think aloud" study on compensatory health beliefs. The "think aloud" technique has been shown to be a valuable tool in highlighting potential problems with self-reported measures (e.g. Gardner & Tang, 2013; McCorry et al., 2013). Thus, this method will be used

to explore potential problems with ORTO-15 that might contribute to its poor validity. In addition to the “think aloud” protocol, to further explore the structure of ORTO-15, Chapter 2 offers a series of confirmatory factor analyses of the scale.

Chapter 3 comprises two studies. Study 1 includes a qualitative exploration of ON. Most studies of ON, so far, have employed quantitative methodologies in their design. This study aimed to develop insight into people’s relationships with food and into people’s day-to-day experiences of possible ON. Semi-structured interviews of individuals displaying orthorexic tendencies with subsequent thematic analysis of the data informed the development of a new measure of ON which is presented in Chapter 4. Study 2 reports on individuals’ nutritional dietary intake assessed using the 24-hour recall method (Nelson et al., 2007). This measure requires the respondents to recall in detail all the food and drink consumed in the last 24 hours. Considering the lack of knowledge about ON diets, this study will seek to identify if ON is characterised by patterns of deficiencies or excesses of nutrient intakes, which could potentially contribute to more accurate diagnostic criteria.

A series of studies in Chapter 4 aimed to develop a new measure of ON. The studies examined a set of items developed based on the qualitative exploration of ON in the previous chapter. A series of psychometric procedures were conducted to achieve internal consistency, factor structure and various forms of validity for the proposed scale.

1.5 Ethical considerations

Ethics approval for all studies included in this thesis was granted by the Faculty of Science Engineering and Computing Ethics Research Committee (FREC). Several ethical considerations were implemented in all studies. Participation was

voluntary and participants had the right to withdraw from studies during the data collection stage, although the actual timing varied depending on the study. For the qualitative interviews, participants could withdraw their data in the first 30 days after completing the measures and were made aware of this option at the recruitment stage. Participants could not withdraw their data from the studies presented in Chapters 2 and 4 due to the anonymity in the process of data collection. No information that could jeopardise anonymity of participants was collected during these studies which means that individual data sets were not identifiable. It was therefore impossible for the research team to identify and remove individual data sets. Participants were informed about this at the recruitment stage. Pseudonyms were used throughout the data collection and analysis in studies presented in Chapter 3. Details that could be used to identify individuals were deleted from the interview transcripts. An information sheet was given to participants at the recruitment stage or was embedded as the first page of the questionnaires when the data was collected via a closed-circuit online platform. Consent was given verbally and implicitly by completion of the interview and all the measures to protect participants' anonymity. All the hard copies of questionnaires were stored under lock and key at Kingston University. Hard copies will be disposed of via the confidential waste disposal system of Kingston University. Interviews were recorded using a password-protected phone and were stored on a password-protected computer. Data collected online were also stored on a password-protected computer. In the case that a participant's eating pattern or nutritional information raised concerns, the researchers suggested that the individual should seek advice from a member of the supervisory team who is a state registered dietitian, or their GP.

Chapter 2. Does ORTO-15 produce valid data for ‘Orthorexia Nervosa’?

Note

Section 2.1 below contains the final version of a manuscript exploring participants’ interpretations of ORTO-15 questionnaire’s items. Manuscript was submitted to the *Eating and Weight Disorders – Studies of Anorexia, Bulimia, and Obesity* journal on the 22 November 2019 and was published on the 22 May 2020. The pdf of this publication can be found in Appendix 1. The manuscript presented in this chapter is unedited except for the table numbering and referencing format.

Two undergraduate students, Albie Aldridge and Emily Crocker, assisted with the data collection as part of their undergraduate summer research internship programme.

Section 2.2 contains Confirmatory Factor Analysis of the ORTO-15 scale conducted using the data from the study in Section 2.1.

2.1. Does ORTO-15 produce valid data for ‘Orthorexia Nervosa’? A mixed-method examination of participants’ interpretations of the fifteen test items.

Abstract

Purpose. Orthorexia Nervosa (ON) is defined as a pathological eating behaviour stemming from being “healthy” or “pure”. Survey-based studies typically rely on the ORTO-15 questionnaire or its variations to detect orthorexia. However, frequent post-hoc adjustments to the ORTO-15 suggest psychometric problems. In this study, we explored people’s cognitions about the ORTO-15 items to (1) identify problems specific ORTO-15 items and (2) explore participants’ understanding of orthorexia nervosa.

Methods. Fifty adult participants (40% male, mean age=34.0±14.4 years) completed the ORTO-15, the Eating Attitude Test (EAT-26) and the Obsessive-Compulsive Inventory-Revised edition (OCI-R). Qualitative data were collected using the modified “think aloud” protocol, which asked participants to ‘verbalise’ their responses to the ORTO-15 items. These qualitative responses were first analysed conjunctively with the quantitative responses; then subjected to thematic analysis.

Results. ORTO-15 identified 64% of the participants for orthorexic tendencies. In most cases (76%), participants reported no issues completing the ORTO-15. However, in some cases, qualitative responses differed from quantitative ones. When people encountered problems, it was because of poor psychometric construction: lack of clarity, ambiguous wording and multiple statements in a single item. Elaborations around the ORTO-15 items formed four major themes: “preoccupation with physical appearance”, “control”, “food is fuel” and “alone not isolated”.

Conclusion. Even though in the majority of cases there were no issues with completing ORTO-15, thematic analysis revealed several discrepancies between our participants’ perceptions of the ORTO-15 items and the previously proposed diagnostic criteria for ON. The results suggest that ORTO-15 is, at best, a mediocre screening tool for ON, which is sensitive to diet but fails to have sufficient level of specificity to detect the pathological stage. More accurate instruments are needed to further research on ON.

Level of evidence: V (cross-sectional descriptive study with qualitative analysis).

Introduction

Orthorexia Nervosa (ON) has been described as a set of behaviours and beliefs characterised by an obsession with “healthy” or pure eating (Bratman, 1997). This fixation on the purity of food as opposed to its quantity is the main feature of ON. According to the proposed diagnostic criteria by Dunn and Bratman (2016), individuals suffering from ON are preoccupied with either affirmative or restrictive dietary practices believed to promote health. Dietary restrictions escalate over time and may cause the exclusion of entire food groups. Violation of self-imposed rules causes a sense of personal impurity, anxiety, and guilt resulting in compensatory behaviours such as an even stricter diet, exercise, or a “cleanse” (attempt at ridding the body of substances perceived to be toxic or unhealthy, often by limiting food consumption to only water or other liquids). Such behaviours may result in unbalanced and insufficient diets, weight loss, and impairment of social and professional lives. Individuals suffering from orthorexia may have difficulty eating with others who do not share their rigid dietary beliefs, place a high value on maintaining control over food preparation and tend to follow a very strict mealtime schedule (Mathieu, 2005; Bratman & Knight, 2000; Barthels, Meyer, & Pietrowsky, 2015).

Despite the growing interest in ON in academia (Dunn & Bratman, 2016; Gramaglia et al., 2017), this condition is not officially recognised as an eating disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (APA, 2013). Some researchers suggest that ON is strongly related to obsessive-compulsive disorder (OCD) (Brytek-Matera et al., 2017; Koven & Senbomatsu, 2013), while others suggest that symptoms of ON overlap with symptoms of Anorexia Nervosa (AN) (Koven & Abry, 2015). Unlike individuals diagnosed with AN, individuals

suffering from ON are not secretive about their preferred diet and do not experience body image disturbances that are based on perceived weight or body shape (Dunn & Bratman, 2016). A neuropsychological study found symptoms of all three conditions (OCD, AN and ON) to be related (Koven & Senbomatsu, 2013). However, it is not clear if obsessive thoughts are a source of distress for individuals suffering from ON, or if compulsive behaviours are aimed at preventing a catastrophic event or at reducing distress. According to eating disorder professionals, despite lacking official recognition, ON is a sufficiently recognised entity in need of further inquiry (Vandereycken, 2011). What makes ON an intriguing condition is that various definitions seem to capture part but not the whole essence of the phenomenon. Reflecting on developments since the inception of the term, Bratman (2017) emphasises the progression of the condition where the first stage is more of a (commendable) lifestyle choice adhering to a healthy diet (and exercise), even if such diet involves unusual and irrational ideas. It is the second stage that is problematic and involves pathological behaviour.

Detecting orthorexia nervosa. The literature on orthorexia has been dominated by the studies aimed at establishing its prevalence in a number of different samples (Donini et al., 2005; Grammatikopoulou et al., 2018; Malmberg et al., 2017; Ramacciotti et al., 2011; Reynolds, 2018). To date, two questionnaires are commonly used to measure the prevalence of orthorexia: the 10-item Bratman Scale (Bratman & Knight, 2000) and the ORTO-15 questionnaire (Donini et al., 2005). The academic community has mostly disregarded and criticised the 10-item Bratman Scale for the lack of validity demonstrated in the research, and for the fact that creators of the scale did not follow standardised statistical procedures when creating it (Missbach, Dunn & Koenig, 2016).

The ORTO-15 questionnaire, which has been the most widely used measure (Cena et al., 2019), consists of 15 multiple-choice questions, six of which were borrowed from the Bratman scale. There are several translations of the original Italian version of ORTO-15, including Turkish, Hungarian, English, and Polish. Responses are scored on a 4-point Likert-type scale, which includes: “always”=1, “often”=2, “sometimes”=3, and “never”=4. Scores above 40 are suggested to indicate the absence of ON. According to the original authors’ instructions, items 2, 5, 8 and 9 are reverse-scored (“always”=4, “often”=3, “sometimes”=2, “never”=1). Items 1 and 13 are scored as: “always”=2, “often”=4, “sometimes”=3, “never”=1.

Concerns about ORTO-15 as a screening tool for orthorexia. The results from prevalence studies using ORTO-15 vary from 6% prevalence in an Italian sample to 88.7% in a group of female nutritionists (Dunn & Bratman, 2016). Interestingly, a recent study with US college students found a prevalence of 71%, although less than 1% experienced impairment in everyday activities and medical problems caused by their diet (Dunn et al., 2017).

Taken together, these results suggest that a large proportion of the samples scored below the recommended cutoff point for ON, and while the ORTO-15 may be sufficiently sensitive to identify a distinct form of eating behaviour, it is perhaps not specific enough to identify orthorexic eating pathology. A good and accurate test must have both high sensitivity (to avoid false negatives) and specificity (to avoid false positives) (Fawcett, 2006).

Recognising potential problems with ORTO-15, Moller and colleagues conducted confirmatory factor analyses of the 15-, 11- and 9-item versions of the scale and concluded that none of the three versions showed acceptable model fit (Moller, Appunthurai, & Knowles, 2018). With eliminating two items from the

shortest scale, the ORTO-7 model was proposed. Items of the different ORTO-scale variants are presented in Table 2.1.

Table 2.1

Summary of Qualitative Elaborations on Each of the ORTO-15 Items in the Context of Different English Variants.

ORTO-15 Items	ORTO-11 version (Arusoglu et al., 2008)	ORTO-9 version (Missbach et al., 2015)	ORTO-7 version (Moller et al., 2018)	Qualitative analysis (Problematic items)
1. When eating, do you pay attention to the calories of the food?	—	—	✓	13
2. When you go in a food shop do you feel confused?	—	—	—	15
3. In the last three months, did the thought of food worry you?	✓	✓	✓	17
4. Are your eating choices conditioned by your worry about your health status?	✓	✓	✓	16
5. Is the taste of food more important than the quality when you evaluate food?	✓	✓	—	21
6. Are you willing to spend more money to have healthier food?	✓	✓	—	10
7. Does the thought about food worry you for more than three hours a day?	✓	✓	✓	12
8. Do you allow yourself any eating transgressions?	✓	—	—	7
9. Do you think your mood affects your eating behaviour?	—	—	✓	6
10. Do you think that the conviction to eat only healthy food increases self-esteem?	✓	✓	—	19

Table 3.1 Continued.

Summary of Qualitative Elaborations on Each of the ORTO-15 Items in the Context of Different English Variants.

ORTO-15 Items	ORTO-11 version (Arusoglu et al., 2008)	ORTO-9 version (Missbach et al., 2015)	ORTO- 7 version (Moller et al., 2018)	Qualitative analysis (Problematic items)
11. Do you think that eating healthy food changes your life-style (frequency of eating out, friends, ...)?	✓	✓	✓	13
12. Do you think that consuming healthy food may improve your appearance?	✓	✓	—	7
13. Do you feel guilty when transgressing?	✓	—	✓	12
14. Do you think that on the market there is also unhealthy food?	✓	—	—	9
15. At present, are you alone when having meals?	—	✓	—	4

Note: Qualitative analysis (Problematic items) – the number of problems participants experienced when responding to the ORTO-15 in the present study.

Although new instruments for detecting orthorexia emerged in Germany, (Dusseldorf Orthorexia Scale (Barthels, Meyer, & Pietrowsky, 2015), United States (Eating Habits Questionnaire (Gleaves, Graham, & Ambwani, 2013), Spain (Barcelona Orthorexia Scale (Bauer et al., 2018) and Teruel Orthorexia Scale (Barrada & Roncero, 2018), the ORTO-15 has remained the most widely used scale in the academic literature on ON, thus warranting the need for further investigation to ascertain if items of ORTO-15 fully capture the construct of orthorexia. Yet, and

despite the recurrent and well-documented problems with ORTO-15 (Heiss, Coffino, & Hormes, 2019; Rogoza, 2019), no attempt has been made to explore the potential reasons for the poor performance.

Aim. This study aimed to investigate the reasons behind the poor performance of ORTO-15 with the view to identify ways for improvement and to facilitate developing new screening tools. Initially, our study aimed to explore people's thought processes about the ORTO-15 items. In line with the "think aloud" methodology, we set out to understand why certain items are problematic. Putative reasons for this could include items where participants are unsure what the statement is about (e.g., contains two issues in one sentence) or have cognitive conflicts (e.g., honestly should answer affirmatively but for a different reason). This initial phase focussed on the functionality of ORTO-15.

Subsequently, we also analysed the qualitative responses to identify congruencies and potential discrepancies between participants' experience of orthorexic tendencies (where applicable) and the existing understanding of the condition in the literature. This phase was conducted retrospectively via analysing participants' thoughts expressed for each ORTO-15 item, not by directly asking participants to elaborate on their views on orthorexia. With this added analysis, we focused on the introspective reflection about the behavioural aspects with the view to investigate which facets of orthorexia, if any, manifest in people's thoughts when responding to items of ORTO-15.

Method

Design. The study used a mixed methods design, incorporating both quantitative and qualitative methods. Participants first provided demographic, self-reported anthropometric and health-related information. Qualitative data consisted

of participants' written "think aloud" responses to the ORTO-15, which were analysed via content and thematic analyses.

In the qualitative component of the study, we asked participants to reflect on and verbalise their thoughts when completing the ORTO-15. We employed a method inspired by the "think aloud" protocol (Ericsson & Simon, 1993), which requires participants to verbalise their thoughts while completing a cognitive task. The "think aloud" method has proven to be a valuable way of exploring how and why respondents arrive at their answers, and to identify problems responders experience when completing a scale. It has been used successfully to examine the content validity of several questionnaires (Darker & French, 2009; French et al., 2007; Gardner & Tang, 2014; Kaklamanou, Armitage, & Jones, 2013; Thorneloe et al., 2017; Van Oort, Schroder, & French, 2011). Successful utilisation of the "think aloud" method may, therefore, offer empirical support for improving psychometric measures. This study's method deviated from the original "think aloud" protocol in two ways: participants' thoughts were captured retrospectively not simultaneously; and in written form not verbally. The current procedure involved recording people's written verbalisations of cognitive processes in response to every item of the ORTO-15. The advantage of conducting retrospective "think aloud" protocol involves a decrease in reactivity whereby performance might be enhanced due to a more structured working process or diminished by a double workload of responding to a question and vocalising the thought process simultaneously. Participants are allowed to provide reflections on the items at their own pace.

Given the lack of understanding of the symptoms of ON, and the potential overlap with other eating disorders and OCD (Koven & Abry, 2015), this study has moved beyond single "think aloud" assessment and included additional

psychometric measures to identify possible link to other disorders; and most importantly their potential influence on how people answer the ORTO-15 items. Thus the quantitative part included two established psychometric measures designed to identify the presence of OCD symptoms and to assess eating disorder risk. All collected data were recorded anonymously. Qualitative and quantitative responses were linked via an alphanumeric participant identification code.

Collection of the sample. Adults residing in the UK with a minimum age of eighteen years old were invited to participate in this study. No exclusion criteria were applied to ethnic background, occupation or sociodemographic status. Individuals had to be able to speak English fluently as a second language or be native English speakers. Participants were recruited from the research team's contacts using the snowball sampling and were approached based on the research team's prior knowledge of existing restrictions in their diet. Several individuals (informants) known to exhibit orthorexic tendencies (i.e. restricted eating behaviour, avoidance of certain foods, particular food beliefs) were approached and asked to participate in this study voluntarily and to help identify individuals known to them that exhibit similar eating patterns. Our purposeful sampling strategy targeted people who were interested in integrating 'clean eating' principles into their daily life; interest; and reported at least some signs of orthorexic eating behaviour. These included self-imposed distinctive and sustained dieting behaviour for health reasons; voluntarily restricted their food based on characteristics of the foodstuff (i.e., omitted certain foodgroups for no medical reasons; or only consumed specific type of food such as organic, raw, etc.). Because the ORTO-15 is designed to screen population for orthorexia, we included a wide spectrum of 'healthy eaters', potentially

problematic and non-problematic, to see if responses to the ORTO-15 items differ between those who score below the recommended cutoff of 40 and above.

Measures. All questionnaires were hosted on a closed survey platform (SurveyMonkey) accessible via a designated link. Demographic information (age, gender, ethnicity, occupation, and current living situation) was collected. Self-reported anthropometric measures consisted of height, current weight, lowest weight, highest weight, and desired weight. Health-related questions enquired about the presence of diagnosed health conditions that might affect eating behaviour.

2.3.1 ORTO-15. The english version of ORTO-15 included 15 original items with a comment box for each question. Responses were scored in accordance with the original authors' instructions. According to the authors of scale, scores below 40 showed a good predictive capability for the presence of ON (Donini et al., 2005).

2.3.2 Psychometric measures:

The Eating Attitudes Test (EAT-26). The EAT-26 (Garner et al., 1982) is a widely used 26-item standardised self-report screening tool used for identifying symptoms characteristic of eating disorders. It consists of three subscales: (1) dieting, (2) bulimia and food preoccupation, and (3) oral control. A score higher than 20 suggests the possible presence of disordered eating [34].

The Obsessive-Compulsive Inventory-Revised (OCI-R). The OCI-R (Foa et al., 2002) is an 18-item self-report measure for assessment of six common OCD symptoms: checking, hoarding, obsessing, ordering, neutralising and washing. Scores above 20 indicate presence of OCD.

Procedure. Participants were asked to voluntarily take part in the study by completing the online questionnaire and to set aside one hour to comfortably complete all steps. They were made aware that voluntary completion of all measures

implied their consent. As part of the recruitment, participants were briefed verbally, and an information sheet was provided as an embedded part of the questionnaire. Participants were then asked to complete the English version of ORTO-15. The following instructions were provided at the top of the page:

After reading the question, select one response from the prescribed list (i.e. “always”, “often”, “sometimes”, or “never”) and then explain the selection that you made in the comments box provided. Ensure that you have fully answered a given question before moving on to the next.

Additionally, the following instructions were presented before each item of the scale:

Please explain why you answered the way that you did (try to be specific, give an example if needed). We would also be interested to know the extent to which you believe that the response you selected accurately reflects your thoughts, feelings and/or behaviours relevant to the question. You may also want to highlight any terms in the question that are confusing or ambiguous.

The comment boxes were inserted to capture participants’ thought processes for qualitative analysis.

Data analysis. Quantitative statistical analyses were performed using IBM SPSS (Statistical Package for Social Sciences) Version 24.0 and JASP (Version 0.11.1) computer software. Bivariate correlation coefficients (r) between EAT-26, ORTO-15 and OCI-R were calculated using the Spearman formula. Associations between categorical variables (binary status of disordered eating, OCD and ON) were tested using chi-square statistics with Fisher’s exact probability. Internal consistency reliability of EAT-26, OCI-R and ORTO-15 are expressed as Cronbach alpha coefficients and McDonald’s omega. Participants’ open-ended

explanations for their response to the ORTO-15 items and feedback about the clarity of the instrument represent the qualitative data. The first author conducted a content analysis (Breakwell, 2012 in Breakwell, Smith, & Wright, 2012) of participants' feedback using the Atlas.ti software to identify any problems participants encountered when responding to the ORTO-15. Taking into account both the think-aloud protocols and the quantitative responses to the ORTO-15 a full coding frame was developed. Codes were based on the discrepancies and difficulties expressed while completing the questionnaire. The coding frame was then applied to all the data. Ten transcripts, chosen using the random number generator, were coded by the second author. The initial between-coder agreement was 85%. The coding frame and the coding were revised after the discussion between the two authors and the agreement increased to 100%. The final version of the coding frame consists of five codes where the fifth code represented "no problems" (indicating there were no problems experienced when responding to an item). The remaining four codes represent problematic responses. The coding frame with codes' definitions can be found in Table 2.2.

Table 2.2.*Coding frame.*

Code and definition	Description	Example quotes from participants
1. Questioned the wording of the item	Participants did not understand and criticised specific words in the questions. This issue had appeared 21 times across ten items when participants expressed doubts about how the questions were worded. Most often this issue appeared in response to item 4 of the ORTO-15. Individuals openly admitted to not understanding some of the words used in ORTO-15.	<p>P16 in response to item 4: When I feel overweight and unhappy with my body image, this motivated me to eat healthier. It particularly works when I start to see a physical change. The question is a little confusing as some people have a different interpretation of a 'health status'.</p> <p>P49 in response to item 8: Transgressing is the wrong word, the implication that my food rules are law is rather extreme. Also, not everybody understands the meaning of transgressing.</p> <p>P18 in response to item 8: I find this question ambiguous, it's not a word I associate with eating. I guess it means going beyond the eating limit?...</p>
2. Did not understand the meaning	When participants did not understand the meaning of the question, provided statements unrelated to the item, and questioned the sensibleness of the item. This problem came up 79 times across all the items when participants struggled to understand what the question was asking. This issue was especially pronounced across items 2 and 10.	<p>P29 in response to item 7: Don't really understand the question.</p> <p>P36 in response to item 2: I don't understand what there is to be confused about!</p> <p>P37 in response to item 14: This question is slightly confusing to understand, but I do think that there is a lot of unhealthy food available, and sometimes this is dressed up as being good for you. However, I am not entirely sure what this question is asking.</p> <p>P1 in response to item 5: Hard question...something that tastes good is not necessarily quality, depending on how you measure it." and "all of this is more complicated than can be answered here...</p> <p>P26 in response to item 2: What do you mean by more money? More than I usually spend? Healthier than what?</p>

Table 2.2. Continued.

Code and definition	Description	Example quotes from participants
3. Agreed only to a part of the question	When participants' answers indicate partial agreement or disagreement with the question often based on additional information, conditions, or situations. This issue appeared 46 times across the data. Most often it was observed in item 5. Participants expressed their agreement or disagreement with the question based on additional reasoning suggesting that they applied their own frame of reference influenced by alternatives created by the individuals to answer this question.	P3 in response to item 12: I think that consuming healthy food can improve your appearance if it is eaten in the right portion sizes... P4 in response to item 12: Eating healthy has been proven to clear skin, but again it's like a placebo, although it works, it doesn't happen overnight. P43 in response to item 5: Sometimes when I'm cooking my own meal I don't worry about what I'm putting in it, I just do what will make it taste better, but if I was out buying food that's when I calorie-count.
4. Qualitative response did not concord with quantitative response to questionnaire item	When there is a difference between the reasoning in participants' comments and their response in the questionnaire. This issue has appeared 35 times across 13 items with the most comments clustering in item 3.	P18 chose "never" as a quantitative response to item 3 while the qualitative comment indicates the opposite to be true: "When I am consciously eating healthy I always worry about my food choices. Especially when having a good social life, it includes a lot of bad food and drink choices which makes me worry about food." P41 also chose the quantitative response "never" while the qualitative comment indicated: "I'm always worried about what to eat due to my weight issues."
5. No problem	When participants did not encounter any difficulties answering the question.	

The first author conducted thematic analysis procedure as defined by Braun and Clarke (2006) to identify whether participants' feedback was related to orthorexic symptomatology. After repeated reading, the "think aloud" transcripts were explored using open thematic coding according to the "bottom-up principle". The coding involved assigning codes to the data based on the semantic and conceptual readings. The next steps involved searching for subthemes by means of revisiting the codes and searching for the meaningful patterns across the data that later were grouped into themes. The emerged themes and subthemes were discussed and agreed upon during meetings between the authors.

Results

Description of the sample. Initially, sixty-six individuals took part in this research. Eight individuals provided demographic information but did not complete any other measures. Their data were removed from the final analysis. Another eight participants reported having medical or psychological conditions that may have an impact on their eating behaviour (i.e., depression, Irritable bowel syndrome, bulimia, anxiety), and their data were therefore excluded. The final sample consisted of 20 males and 30 females, mean ages of 34 years ($SD = 16.3$) and 35 years ($SD = 13.2$) respectively. The majority were of White British descent (88%), and over half (52%) lived with a partner, with an additional 30% living with parents. The average BMI was 25.3 kg/m^2 ($SD = 6.9$).

Quantitative Analysis

Descriptive statistics. The mean score for the ORTO-15 was 37.82 ($SD = 4.19$) with 64% of the sample scoring in the ON range. The OCI-R mean score was 12.14 ($SD = 9.65$), and the EAT-26 mean score was 10.08 ($SD = 8.99$), indicating

that generally, the sample had a healthy eating attitude. Seven of the 50 participants (14%) were identified as being potentially at risk for disordered eating. Eight participants (16%) were identified for showing OCD tendencies.

Internal consistency reliabilities. The internal consistency reliability of the ORTO-15 in this study was found to have a Cronbach's alpha score of .47, which is considered to be very low. McDonald's omega coefficient was .56.

The Cronbach's alpha value of .88 for the OCI-R was calculated from this study's sample which signals a good internal consistency reliability of the scale. McDonald's omega coefficient was .89.

The Cronbach's alpha value for EAT-26 in the present study was .86, also indicating good internal consistency reliability. McDonald's omega coefficient was .85.

Omega coefficients are interpreted in the same manner as Cronbach's alpha. The difference between the observed alpha and omega coefficients lies in the models that define alpha (essential tau-equivalence) and omega (congeneric). In this study, the discrepancy between alpha and omega coefficients of ORTO-15 may have resulted from the violation of essential tau-equivalence model (the assumption of error score of any pair of items is uncorrelated). If this assumption is violated, the true reliability is underestimated (Graham, 2006).

Associations. Key findings from the correlation analysis were as follows: ORTO-15 score was significantly and negatively correlated with the EAT26 score ($r = -0.66, p < 0.001$) and the OCI-R score ($r = -0.30, p = 0.03$). Furthermore, a statistically significant but weak positive correlation was observed between the EAT26 and OCI-R test scores ($r = 0.33, p = 0.02$). (Note that 'at risk' status is

indicated by high scores on EAT-26 and OCI-R but low scores on ORTO-15, which explains the negative correlation).

Qualitative Analysis

Content analysis on the functionality of ORTO-15. Content analysis of the “think aloud” responses revealed that participants did not encounter problems while filling in the ORTO-15 for the majority of the time (76%). However, a total of 179 problems were identified. Responses were classified as “no problem” unless there were “think aloud” data to the contrary. The mean number of problems per participant was 3.44 with a range of 0 to 9. The coding frame, the definitions of the problems and the quotes from participants are presented in Table 2.2, while Table 2.3 presents the frequency distribution of the identified problems.

Table 2.3.

Frequencies of Codes Distributions.

Codes	Items														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0	1	2	4	2	1	3	2	0	1	0	0	3	2	0
2	4	12	5	6	6	4	5	3	3	13	4	2	5	5	2
3	6	0	0	3	10	3	2	1	2	4	6	5	2	2	0
4	3	2	10	3	3	2	2	1	1	1	3	0	2	0	2
5	38	35	33	34	29	40	38	43	44	31	37	44	38	41	46

Content analysis revealed the item that participants had the most problems with was item 5 (Is the taste of food more important than the quality when you evaluate food?) Most often participants suggested alternative reasoning that the taste

is better if the food is of good quality and overall, the two concepts are inseparable. Item 15 (At present, are you alone when having meals?) was the item that elicited the fewest issues. Participants offered comments in a “yes” or “no” format without further elaboration. Most individuals gave an affirmative answer to item 14 (Do you think on the market there is also unhealthy food?). However, the endorsement of this statement does not always mean a higher likelihood of meeting the criteria for ON.

The scale demonstrated a very low coefficient of internal consistency reliability ($\alpha = .47$) which is to be expected considering the number of problems identified. Participants struggled to comprehend the meaning of the item 2 “When you go in a food shop, do you feel confused?”. It was unclear to participants why going to a shop would elicit confusion. Another item that was met with a similar reaction is “Do you allow yourself any eating transgressions?”. Many participants did not know what the word “transgressions” meant. Understanding the question is the first step participants take when completing a questionnaire. To avoid variation in question comprehension researchers are advised against the use of ambiguous and unfamiliar words (Missbach et al., 2015).

Thematic analysis on the behavioural aspects in ORTO-15 items.

Participants’ elaborations went further than just simply identifying potential problems with ORTO-15. Therefore, thematic analysis of the transcripts was conducted to identify whether participants’ “think aloud” data are linked to the concept of ON and the proposed diagnostic criteria. Four themes were identified: “preoccupation with physical appearance”, “control”, “food is fuel”, and “alone not isolated”. Participants are identified by numbers and their respective scores on ORTO-15 are provided in brackets.

Preoccupation with physical appearance.

For the majority of participants in this study, striving for a healthier diet was motivated by their desire to manage their weight. Participants mention an improvement in physical appearance as the factor that drove them to start eating healthier. Participants identify this improvement in physical appearances, such as weight loss or clearer skin as a direct cause of adherence to the self-imposed diet. These quotes from the transcripts illustrate the point: P1(38): “I have been trying to lose weight, so I was concerned about eating certain things...I wouldn’t say I was worried, but I was conscious of what I was eating.” P10(37): “The experience I have of this is that my skin looks better and keeping an eye on calorie content means I have more control over my figure and therefore appearance...” For many participants in our study weight loss has come to represent their ability to achieve health and well-being.

Control.

The second identified theme can be defined in terms of participants’ perceived control over their eating behaviours and exercise routines. Participants reported having a strict routine that involved planning meals and regular exercise. People experienced negative emotions if the self-imposed routine wasn’t followed and tried to compensate for it by an extra workout or a stricter diet the next day. For example, P24(41) reported: “I feel guilt if I am not getting to eat in my usual healthy manner”.

Transgressions did not cause any adverse emotions if they were planned and incorporated into the diet. For example, in response to “Do you allow yourself eating transgressions?” P6(42) provided: “Yes small transgressions which I would call treats!” In response to item 13 (Do you feel guilty when transgressing?) P27(39) replied: “it’s a conscious decision, so it would seem illogical to me to then feel

guilty. I would factor that into the decision itself.” In fact, by allowing themselves controlled deviations from their diets, participants reported a higher likelihood of adherence.

P47(39) described the role of these deviations: “For the long term, a small transgression avoids completely going off the rails and binging.” Planning served as a protective factor against worry, guilt, and provided a sense of being in control in social situations when participation involved consumption of alcohol and food thought to be unhealthy.

“Food is fuel.”

This theme describes the participants’ relationship with food. The comments indicate how discourse about food has moved to a view of food as a source of “fuel” for maximising health or physical performance. For example, P41(34) expressed: “I prefer healthy food as then I know my body has the best fuel.” Participants believed that a healthy diet has a direct impact on psychological well-being and physical health:

“What you put into the engine determines how it runs. Again back to vitality. If you are always down, low energy and no get up and go, then the diet in most cases is the cause. Tiredness is the huge issue for women and men with young families, so high energy and protein is important when you lack sleep. For most health issues if you can detect them early enough, food can make a marked difference.” (P31(34). P21(36): “I believe there is a connection between eating healthily and feeling good about oneself, physically and mentally. I know I’m more likely to engage in healthier activities and exercise when I’m following a healthy eating plan, which in turn increases the sense of well-being.”

Participants linked health as a central organising factor in their practices of food selection. A particular perception of the body as a machine that needs the best quality nutrients to perform at its best has emerged from the transcripts.

It appears individuals in this study were faced with a constant challenge to sort through the food-related information and were preoccupied with the evaluation of risks and benefits of food. Participants demonstrated a high level of confidence in their knowledge of nutrition and defined their relationship to food as a never-ending process of information seeking and self-education potentially with a limited scientific basis. On the other hand, some individuals found this strive for nutritional knowledge very distressing and expressed uncertainty about the nutritional information they encounter on a day-to-day basis. P3(35) has expressed a general mistrust to food-related information offered on the market: “There are so many food items out there now that claim to be healthy or better for you but all with hidden sugars and salt. It can be very confusing to know what is best to eat and best to buy.”

“Alone not isolated.”

This theme describes various social contexts within which participants described their food choices and practices. Impairment of social life resulted from an excessive focus on healthy eating has been implicated in one of the diagnostic criteria proposed by Dunn and Bratman (2016). This study, however, did not yield support for this assumption. Participants did report being alone during meal times which was not experienced as social isolation but was rather a conscious preference or reflected individuals’ living situations:..P46(37): “I live alone so yes am always on my own when I eat breakfast and dinner, lunch at work.”

P38(35): “Monday to Friday I have lunch at work I bring food from home cooked by me the night before I usually eat with colleagues. Evenings and weekends I eat with my husband.” The importance assigned to following a healthy diet outweighs the need for social interaction. Furthermore, some individuals perceived social engagements as an obstacle to a healthy lifestyle:

P17(31): “I feel like my social life always gets in the way of eating healthily. If I am eating healthily, I am less likely to go out and have a social life as I become too tempted to eat the wrong foods...”

Even though the data suggest that participants’ social lives were affected by their diets, psychological discomfort, proposed by previous research, caused by social isolation was not reported in this study.

Discussion

The main purpose of this study was to explore the nature and extent of problems individuals encounter when they complete the ORTO-15. This study also sought to compare participants’ responses to ORTO-15 with three additional questionnaires measuring related phenomenon to further determine the validity of the ORTO-15. As in previous studies employing the “think aloud” technique (Darker & French, 2009; Van Oort, Schroder, & French, 2011), participants did not encounter any difficulties responding to the scale the majority of the time. The success of the think-aloud technique depends on participants’ ability to verbalise their thoughts, and individuals differed in their performance throughout the task. Because the responses were coded as “no problem” unless “think aloud” data indicated otherwise, it is important to acknowledge that the issues with the scale might have been underestimated.

Prevalence of ON by ORTO-15. Those participants in this study who were identified for ON by the ORTO-15 scored just below the cut-off point of the ORTO-15. Consistent with previous studies using the ORTO-15, the putative prevalence of ON symptoms was relatively high (70% of the sample) compared to the prevalence of AN in general population (0.9% among women and 0.3% among men) (Hudson et al., 2007). Similar findings were previously observed in other countries where researchers used the ORTO-15 to assess the prevalence of ON in various populations (Arusoglu et al., 2008; Missbach et al., 2015; Ramacciotti et al., 2011). This study found a significant negative correlation between the scores of ORTO-15 and both OCI-R and EAT-26. Lower scores on ORTO-15 indicate the presence of ON while higher scores on OCI-R and EAT-26 indicate the presence of OCD and eating pathology. Observed negative associations, therefore, suggest that there are overlaps between ON and symptoms of other eating disorders as well as OCD. The association between ORTO-15 and EAT-26, however, needs to be interpreted with caution since there is similarity between items in these questionnaires.

Functionality of ORTO-15. Problems were identified across all items, and 46 out of 50 participants encountered at least one issue. Four individuals did not elaborate any ‘think aloud’ data but responded to the scale items. Their contributions were, therefore, coded as ‘no problem’. Items that elicited the biggest number of issues were: 5, 10, 3, 4, & 2. In a study by Moller and his research team (2018), items 5, 2 and 10 were highlighted as problematic and dropped from the developed ORTO-7 as shown in Table 2.1. Item 15 elicited the least confusion. However, the wording of this question does not allow for the intended concept of social isolation to be identified as potentially causing distress. Even though the nature and frequency of the problems varied, all items elicited at least one issue.

Orthorexic Traits: Comparing reflection on the behavioural components of ON with other disorders. Results of the thematic analysis in this study support the hypothesised overlap of obsessive-compulsive and eating disorder traits in ON. The identified “control” theme is a factor underlying participants’ adherence to self-imposed diets. Previous studies have recognised the importance of personal control in eating disorder symptoms and OCD (Froreich et al., 2016). For example, people suffering from OCD often perform strict monitoring of their thoughts and actions and impose rules to dictate their behaviour. Behaviours such as checking, hoarding and performing rituals may be understood as attempts at establishing control. What the participants in the current study described are very similar to the attempts at establishing control over one’s environment experienced by individuals suffering from OCD. Control has also been studied for its connection to AN (Froreich et al., 2016; Waller, 1998). Fairburn and colleagues, for example, proposed that within the AN framework being successful at controlling one’s body shape and weight is an indicator of self-worth and overall self-control (Fairburn, Shafran, & Cooper, 1999). Also, many individuals report beginning to diet at a time of their lives they perceived to be chaotic and beyond their control (Espindola & Blay, 2009). Results of this study suggest that control, despite being one of the symptoms implicated in AN and OCD, might be one of the main features of ON.

Despite literature suggesting that ON’s most pronounced difference from other eating disorders is the motivation for following a diet of choice, our data revealed that the desire to lose weight was a significant factor. In past research, weight loss as a behavioural motivator was linked with the symptoms of AN (Habermas, 1996), while the lack of desire to lose weight is one of the most critical factors separating ON from other eating disorders (Dunn & Bratman, 2016). Similar

to this finding, a recent study investigating a possible link between ON, perfectionism, body image, and attachment style has identified that fear of becoming overweight and a greater focus on appearance to be associated with lower scores on the ORTO-15 (Barnes & Caltabiano, 2017). Physical appearance as a main motivating factor for following a “clean” diet could have a bigger role in ON than previously suggested.

Another identified theme sheds light on participants’ social lives: the data suggest individuals did not place any importance on the social rituals surrounding food consumption. It may be that this phenomenon is experienced by society as a whole and does not indicate the presence of ON. Nicolosi (2006) proposed that orthorexia as a concept can be extended beyond individual pathology to describe a social phenomenon. Nicolosi argues that individuals in modern society are constantly reminded of the importance of diet on their physical health while at the same time the distance between them and food production grows. People have less and less knowledge about how food is managed, processed, and sometimes prepared while the discourse about healthy eating in popular media intensifies. This lack of knowledge about food production and intense discussion about risks and benefits of a healthy diet is at the core of rising dietary anxiety and food risk perceptions (Rangel, Dukeshire, & MacDonald, 2012). In today’s society, family meals are often sacrificed for work responsibilities. For the participants, social isolation was not a cause for distress but rather a general aspect of changing social habits. It is possible that this phenomenon is a societal norm and not indicative of ON and therefore not valid in terms of diagnosis. Themes identified in this study suggest that ON might have more in common with AN and OCD than was previously suggested.

In addition, some concepts (e.g. social isolation and a lack of consideration for one's weight) did not seem relevant to the experiences of participants in this study.

Limitations

Our study has its limitations, among which are those of the “think aloud” method. The “think aloud” protocol states that participants are meant to verbalise their thoughts while completing a scale, in this study the data were collected online which limits researchers' supervision over the process. For future research, it would be beneficial to conduct in-depth interviews to explore people's experience of ON and contribute to the creation of a reliable diagnostic tool. Another improvement would be to carry out a nutritional assessment of participants' diets. Research in the field of ON is still scarce, and to date, there are no universally accepted diagnostic criteria. Without a proper dietary assessment, it is impossible to ascertain if the orthorexic diet does lead to malnourishment as some of the proposed diagnostic criteria claim. Future research should focus on developing a new diagnostic tool as well as investigate the nutritional composition of the orthorexic diet.

Another possible limitation to this research is the modified procedure of the “think aloud” protocol. Concurrent variation of the protocol might have provided a richer account of the potential issues with the scale. Non-verbal information (pauses, utterances, body language) that concurrent “think aloud” procedure provides could contribute to further understanding of the difficulties people experienced when responding to ORTO-15.

Conclusion.

In conclusion, this study attempted to identify problems people experience completing the ORTO-15. We have conducted a “think aloud” protocol to address the issues with the scale. Thematic analysis of the data has brought forward aspects

of ON previously overlooked in the research. The instrument's validity was under scrutiny by earlier research, and our results highlight a number of problems with the ORTO-15. The ORTO-15 is not an adequate scale to detect orthorexic behaviours and attitudes. Taking the qualitative and quantitative results together, it appears that at best, ORTO-15 taps into diet habits and lifestyle (stage one) but fails to detect the pathological aspect (stage two). To date, several questionnaires have been developed. However, attempting to identify prevalence rates of a condition that is yet to be defined is at best premature. More effort should be directed at determining ON as a valid construct.

2.2 Confirmatory Factor Analysis of the ORTO-15 scale.

Background. Internal consistency reliability of the ORTO-15 in the study above was found to be low according to both, Cronbach's alpha (score of .47) and McDonald's omega (score of .56), measures. Additionally, confirmatory factor analysis performed by Moller et al. (2018) revealed that the fifteen-item version was not a fit for their data. A confirmatory factor analysis (CFA) was performed to further investigate the reason for the discrepancy between alpha and omega scores obtained in this sample and to determine if unidimensional factor model fit the data

Method. All measures and participants are identical to the study presented in section 2.1 of this chapter.

Statistical analysis. To test whether ORTO-15 model fit the data CFA was performed using SPSS AMOS software version 23.0 (Arbuckle, 2014). Absolute and comparative fit indices were generated and assessed. Absolute fit indices indicate how well the model fits the data. These included Chi-squared (χ^2), root mean square error of approximation (RMSEA), and standardized root mean square residual

(SRMR). The Chi-squared statistic would yield an insignificant result if the model fits the data (Barrett, 2007). However, Chi-square statistics has been criticised for its sensitivity to sample size (Hooper et al., 2008). To minimise the impact of sample size on the model Chi-square Wheaton et al.'s (1977) relative/normed chi-square (χ^2/df) ratio was assessed. According to Tabachnik and Fidell (2007) an acceptable ratio for this statistic is 2:1. The RMSEA cut-off point of values above 0.07 indicates a poor fit, while values less than 0.03 represent excellent fit (Hooper et al., 2008). Values for the SRMR range from 0 to 1 with models obtaining value as high as 0.08 suggested as acceptable fit (Hu & Bentler, 1999).

Comparative fit index (CFI) was assessed as this statistic takes sample size into account and performs well with data where sample size is less than 200 (Tabachnik & Fidell, 2007). Values for this statistic range between 0 and 1 with values greater or equal to 0.95 indicating a good fit (Hu & Bentler, 1999).

Results

Model fit. The Chi-square coefficient indicated poor fit of the model to the data, $\chi^2 = 146.51$ (90), $p < .001$. Relative/normed $\chi^2(146.51/90) = 1.63$, $p = .00$, however, indicated that model was an acceptable fit. RMSEA value of 0.113 also indicated a poor fit, as it is higher the suggested cut off value of 0.07; SRMR = 0.12 which is higher than 0.08 indicating a poor fit. Obtained CFI value of 0.732 also indicated a poor fit. The 1-factor model is presented in Figure 2.1.

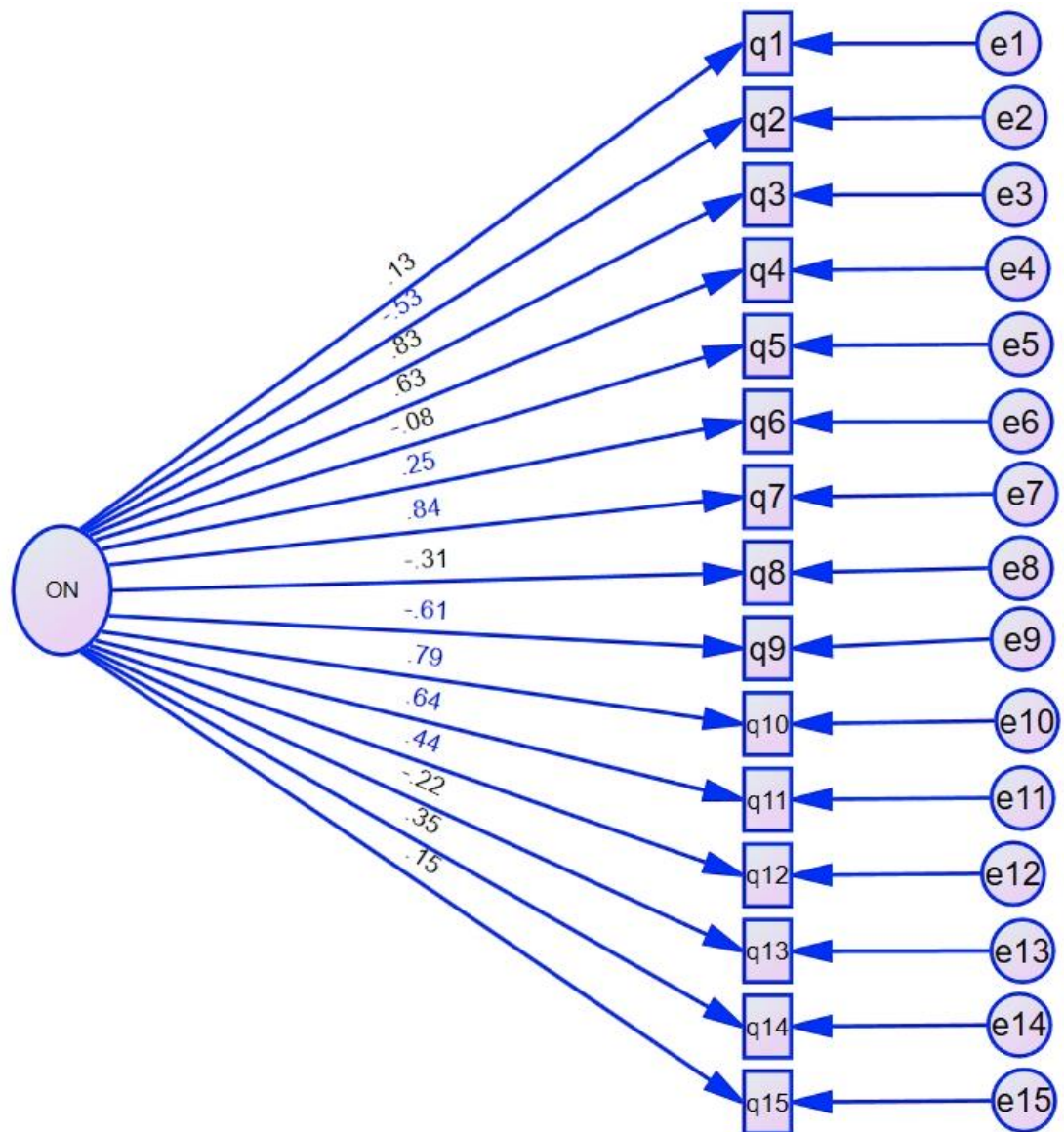


Figure 2.1. ORTO-15 factor structure (1-factor structure). The displayed values are standardized regression weights in a 1-factor structure. Squares represent items (e.g. q1 = item 1 of the ORTO-15), oval circle represent factor (ON- Orthorexia Nervosa), small circles represent error term (e.g. e1).

2.3. Internal consistency reliability

To explore the reason behind the discrepancy between alpha (.47) and omega (.56) assumptions underlying the measurement models of both coefficients were checked via the CFA procedure. Calculations of the reliability coefficients alpha and

omega are based on two different measurement models. Alpha coefficient is based on the essentially tau-equivalent measurement model, which assumes that each item measures the same latent variable (unidimensionality), on the same scale, but with possibly different degrees of precision (allows true scores of the items to have different means and error variances, but assumes constant item variances) (Raykov, 1997a). When the assumptions of the essentially tau-equivalent model are not met alpha does not perform as representative of scale's internal consistency (Green et al., 1977). Dunn et al. (2014) suggest that the assumption of true score variance as constant is problematic in practice as the possibility of equal sensitivity of all items in a scale is unrealistic. Factor loadings presented in Table 2.4 reflect that not all items of the ORTO-15 are correlated with the one latent variable, in this case ON. The differing degree of items' sensitivity to ON represents a violation of assumptions of the essentially tau-equivalent measurement model.

Table 2.4.

Standardized regression weights and squared multiple correlations values for 15 items of the ORTO-15.

Items	Factor loadings *	R ^{2**}
q1-When eating, do you pay attention to the calories of the food?	.127	.016
q2-When you go in a food shop do you feel confused?	-.534	.285
q3-In the last 3 months, did the thought of food worry you?	.830	.689
q4-Are your eating choices conditioned by your worry about your health status?	.629	.395
q5-Is the taste of food more important than the quality when you evaluate food?	-.082	.007
q6-Are you willing to spend more money to have healthier food?	.248	.062

Table 2.4. Continued.

Standardized regression weights and squared multiple correlations values for 15 items of the ORTO-15.

Items	Factor loadings [*]	R ^{2**}
q7-Does the thought of food worry you for more than three hours a day?	.836	.699
q8-Do you allow yourself any eating transgressions?	-.312	.097
q9-Do you think your mood affects your eating behaviours?	-.612	.374
q10-Do you think that the conviction to eat only healthy food increases self-esteem?	.785	.617
q11-Do you think that eating healthy food changes your life-style (frequency of eating out, friends, ...)?	.645	.416
q12-Do you think that consuming healthy food may improve your appearance?	.439	.193
q13-Do you feel guilty when transgressing?	-.217	.047
q14-Do you think that on the market there is also unhealthy food?	.353	.125
q15-At present, are you alone when having meals?	.155	.024

Note: ^{*}Factor loadings - Standardized regression weights.

^{**}R² – Squared multiple correlations.

Values in bold indicate factor loadings above 0.3.

Five questions of the ORTO-15 (q1, q5, q6, q13, q15) displayed factor loadings below 0.3, which are considered low (Kline, 2000). Low factor loadings indicate low correlations of an item with a factor. This is in line with results from CFA study conducted by Moller et al. (2018), which excluded items 5, 6, 13 and 15 from the final 7-item version of ORTO-15 that provided an acceptable model fit. Furthermore, several items (q2, q5, q8, q9, q13) displayed negative factor loadings.

Negatively loaded items normally indicate reverse-scored items in the scale. These items, however, were recoded according to the original authors' (Donini et al., 2005) instructions prior to the analysis, which represents that these might be poor items to indicate the factor.

A short version of ORTO-15 was investigated by Rogoza (2019) using meta-analytical technique with items generally kept in all variants. These items were 3, 4, 7, 10, 11, and 12. Repeating the CFA with these items resulted in almost all fit indices indicating a good fit. $\chi^2(14.33/9) = 1.59, p = .111$; RMSEA .11 SRMR .069; CFI .956; PNFI .536. The only index that indicated a poor fit was the RMSEA.

Figure 2.2 below presents the model fit.

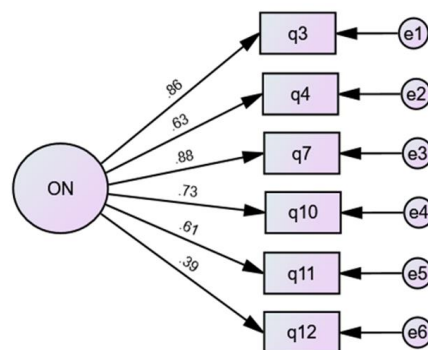


Figure 1.2. ORTO-15 factor structure (1-factor structure) for 6 items. The displayed values are standardized regression weights in a 1-factor structure. Squares represent items (e.g. q3 = item 3 of the ORTO-15), oval circle represent factor (ON-Orthorexia Nervosa), small circles represent error term (e.g. e1).

Rogoza (2019) suggested that despite the valid criticisms of this scale, the 6-item measure could be used as a general marker of ON. Recently, the 6-item scale

was evaluated for its potential to replace ORTO-15 altogether. Rogoza and Donini (2020) attempted to refine the scale and verify the factorial structure using the original data used to develop ORTO-15 (Donini et al., 2005). The results were in line with the findings of the present study. Three and one factorial models of the 15 items demonstrated a poor fit, whereas a six-item version (termed ORTO-R) fit the data well albeit some problems (Rogoza & Donini, 2020). However, one potential limitation to the present study may have been the small sample size ($N = 50$). Values for most fit indexes are affected by sample size (Marsh, Balla & McDonald, 1988). For example, Shevlin and Miles (1998) suggested that the Goodness of Fit Index (GFI) performs poorly with small sample sizes and recommend the sample size of at least 100.

2.4. Accuracy of the ORTO-15

Taken together, the results of Study 1 in this chapter suggest that a large proportion of the sample scored below the recommended cut-off point for ON, which indicates the presence of orthorexic tendencies. While the ORTO-15 may be sufficiently sensitive to identify a distinct form of eating behaviour, it is perhaps not specific enough to identify orthorexic eating pathology. A good and accurate test must have both high sensitivity (to avoid false negatives) and specificity (to avoid false positives) (Fawcett, 2006). The very high rate of identified ON cases in previous studies implies sensitivity but in the absence of an agreed clinical diagnostic measure, accuracy of ORTO-15 cannot be fully assessed. In addition, identification of the cut-off scores in the original study (Donini et al., 2005) was based on a combination of participants' scores on obsessive-phobic traits measured by the Italian version of Minnesota Multiphasic Personality Inventory (MMPI, Mosticoni & Chiari, 1985) and assessment of health content of participants' diets.

The key to utilisation of the Receiver Operating Curve (ROC) analysis for establishing cut-off scores is a presence of the known “gold standard” group (Fawcett, 2006). While the MMPI was developed to identify people with general obsessive-compulsive tendencies (Hathaway & McKinley, 1989), it is not known how well it could represent a “gold standard” of obsession with “healthy” eating. The second measure that was used to define the group with ON was a self-report of food categories in participants’ diets, which might be an indication of self-perceived health content of the diets but not a validated or diagnostic measure of eating pathology. The “golden standard” group at the development stage could have included individuals that were consuming a diet perceived as healthy and showed obsessive tendencies that might have been independent of eating behaviour. Additionally, Donini et al. (2005) prioritised sensitivity over specificity (at cut-off <40) when developing the ORTO-15, which if considered together with the lack of the “gold standard” group could be the cause of the unusually high prevalence rates reported in studies using the scale (e.g. 81.8 % among opera singers, Aksoydan & Camci, 2009).

2.5 Conclusion

Following from the results of Study 1 of this chapter and the CFA it can be concluded that ORTO-15 is at best a mediocre measure of ON that identifies individuals on a diet, not necessarily representative of ON. ORTO-15 demonstrated poor functionality, low indicators of internal consistency reliability, and unclear factorial structure. Taken together, the results emphasise the need for development of independent measure of ON. The new measure should be based on proposed diagnostic criteria. The next chapter aims to explore the dietary intakes of individuals displaying orthorexic tendencies and understand their experiences of this

condition, which contributes would help to clarify the diagnostic criteria and develop a new tool

Chapter 3. Qualitative and nutritional explorations of ON.

Note

Section 3.1 below contains the final version of a manuscript exploring reasons for dietary restriction. Manuscript was submitted to the *Qualitative Health Research* journal on 28 July 2020 and is currently under review. However, the study in its current form was rejected by the journal and has now been submitted to the *Journal of Human Nutrition and Dietetics* in an edited version.

Section 3.2 contains the final version of a manuscript assessing micro- and macronutrient intakes of individuals with possible ON. Manuscript was published in the *Journal of Human Nutrition and Dietetics* on 30 July 2020. PDF of the published article can be found in Appendix 2. This manuscript is unedited except for table/figure numbering and referencing format.

3.1 Study 1. “Why orthorexia? Exploring reasons for dietary restriction: A qualitative study”

Abstract

Orthorexia Nervosa (ON) has been gaining an increased attention in the academia. Qualitative studies exploring experiences of possible ON have just started to emerge. This study aims to explore reasons and behaviour of individuals exhibiting signs of ON. Ten individuals (two males and eight females), aged 23 to 35 years, took part in semi-structured interviews. The research was conducted from the ontological perspective of pragmatism. Pragmatism as a paradigm avoids abstract

debates on the nature of reality and truth advocates for a plurality of methods, suggesting research question to be the guiding principle when selecting the appropriate methods (Kaushik & Walsh, 2019). Inductive thematic analysis was used to identify themes. Four themes emerged from the data - journey, social, rules/control, and ethical considerations – and highlighted contributing factors to development of possible ON behaviours, the impact of these behaviours on individuals' social lives, and the strive for control. Findings contribute to the understanding of ON as a more complex behaviour than its current definition and highlight the need for considering the individual variety of reasons for restricted diet when developing diagnostic criteria and screening tools for ON.

Introduction

Eating behaviour is a complex phenomenon. Despite extensive research, the factors determining eating behaviour are not fully understood. With the majority (63% in 2018) of adults in England being overweight or obese (NHS Digital, 2020) society is facing an increase in obesity related illnesses while simultaneously striving for a modern 'ideal body' type, which is either thin (Volonte, 2019) or 'strong and skinny' (Wiklund et al., 2019). This drive has been related to the spread of eating disorders and body image disturbances (Thompson & Stice, 2001) as well as low self-esteem (Groesz et al., 2002). Both, the rise in obesity rates and the strive for the 'perfect body' indicate that more and more people are preoccupied with their weight and diet in an attempt to change it (Julia et al., 2014). In response to the growing concerns about the impact of unhealthy eating behaviours, several countries have developed recommendations for nutritional composition of a healthy diet (e.g. Department of Health, 1991; Public Health England, 2016; Willett et al., 2019). However, healthy eating is a concept that is interpreted individually and even though

a strive for a healthier diet is a step towards conscious nutrition, in some cases it may be taken too far.

Bratman coined the term Orthorexia Nervosa (ON) to describe an extreme preoccupation with healthy eating he observed in his patients in 1997 (Bratman, 1997). Much research has been done since then and several attempts were made to define diagnostic criteria for ON (Cena et al., 2019). According to Dunn and Bratman (2016), ON is characterised by an obsessive preoccupation with “healthy eating”, which often results in exclusion of food groups perceived to lack purity; compensatory behaviours in the form of even stricter dietary restrictions or “cleanses” if self-imposed restrictions are violated. In addition, individuals often have impaired social, vocational or academic functioning, and adherence to what is perceived to be a healthy diet, which is used to justify self-worth and identity. Qualitative research of ON is scarce with the majority of studies focusing on developing diagnostic tools (e.g. Barrada & Roncero, 2018; Chard et al., 2019; Donini et al., 2005; Gleaves et al., 2013), measuring ON’s prevalence in various populations (e.g. Almeida et al., 2018; Alvarenga et al., 2012; Asil & Sürücüoğlu, 2015) and investigating its links to recognised eating disorders, as well as Obsessive-Compulsive Disorder (OCD), poor body image, drive for thinness and perfectionism (McComb & Mills, 2019). There is no consensus, however, on diagnostic criteria or a diagnostic tool to date. The current thinking on ON highlights the need for further research to explore the quality of life and life satisfaction of those with possible ON (Strahler & Stark, 2020). A desire to consume a healthy diet is not pathological in itself, and research effort should, therefore, be directed towards understanding the difference between restricted eating motivated by a strive for health, and ON.

Whether restricting food intake leads to health benefits or to development of pathology often depends on motivation, reasons, attitudes, and thoughts that people experience before changing their eating patterns (Gulliksen et al., 2016). The role of cognition in changing eating behaviours has been explored, for example, intention to eat healthily translated into increased fruit and vegetable intake in a study that applied the theory of planned behaviour to healthy eating (Conner et al., 2002). Further theoretical advancement emphasised the role of reasons for adopting a behaviour in Behavioural Reasoning Theory (BRT) which suggests that reasons represent an important dimension linking beliefs, intentions, behaviour, and global motives (attitudes, subjective norms and perceived control). Reasons represent an important addition to this theory and in addition to predicting global motives they are expected to impact behavioural intention directly. Reasons help individuals to navigate the world by providing them with causal justification for their behaviour and those around them (Westaby, 2005). It is hypothesised that to execute a behaviour with confidence people rely on experiences from the past that have the most justifiable set of reasons. In particular, the theory distinguishes between the “reasons for” and “reasons against”. This theory began to gain some prominence and has been applied to some health behaviours (Sahu et al., 2020). The applications include exploring reasons for binge drinking (Norman et al., 2018), reasons for using and abstaining from controlled performance and appearance enhancing substances (Lazuras et al., 2017), and reasons for organic food consumption from a marketing perspective (Ryan & Casidy, 2018). BRT, aside from the exploration of organic food consumption, has not been applied to eating behaviours. In this article BRT will be used to understand the reasons, motives, and beliefs behind orthorexic tendencies.

To date, only four studies attempted to explore experiences of people with possible ON using qualitative methodology (Cinquegrani & Brown, 2018; Fixsen et al., 2020; McGovern et al., 2020; Valente et al., 2020). Food intolerances and preoccupation with beauty ideals were shown to be associated with a lower preoccupation with healthy eating, while worry about future chronic disease was associated with higher preoccupation with healthy eating (Valente et al., 2020). In contrast, a study by Fixsen et al. (2020) reported the strive for an ideal body is one of the motives for following the diet of choice among individuals identifying with healthy eating that has taken over their lives. McGovern et al. (2020) interviewed individuals who self-identified as recovered from ON and reported external influences (e.g. health professionals) to be key in the onset of ON. Retrospective accounts highlighted negative emotional states, obsessive tendencies, and difficulties socialising as experiences of ON. However, participants in this study have also reported prior or co-occurring eating disorders (i.e., bulimia nervosa, anorexia nervosa and binge eating disorder), which might have had influenced individual's narratives. The common feature outlined in all existing qualitative studies is the external social influence on the development of ON, emphasizing the need for further explorations to determine other contributing factors. Establishing the meaning people currently displaying ON tendencies assign to their eating behaviour could potentially contribute to better understanding the symptoms, the development, and inform the diagnosis of ON. This article therefore aims to contribute and extend current qualitative understanding of the reasons, beliefs, and motives of individuals with possible ON for following their diet of choice.

Methods

Participants. Ten individuals (eight females and two males) aged over 18 years were interviewed in this study. Mean age of participants was 28.3 years. Participants were known to the research team from personal and professional contacts. Six individuals were employed in the fashion industry, one student in a nutrition and sport science degree, one individual employed as a psychology researcher, and two participants were recommended by other participants based on the similarity of their eating restrictions. The exhibited eating restrictions were reflective of possible ON symptoms defined by Dunn and Bratman (2016). The lack of officially recognised diagnostic criteria and tools make recruitment of participants to studies attempting to explore ON challenging. In this study, participants were selected based on observations of eating behaviours and attitudes made by the research team. Nine participants were known to the research team from personal and professional contacts while one participant was recommended by another participant based on the similarity of the eating patterns and attitudes. All participants claimed to adhere to a “healthy” diet, expressed very specific beliefs about foods’ properties (e.g. “onion is bad for my chakras”), reported little variation in their day-to-day dietary consumption, and expressed a sense of satisfaction reliant on adherence to the chosen diet. Table 3.1 reports participants’ demographic characteristics, employment status, self-identified dietary preferences, and their scores on ORTO-15 questionnaire (Donini et al., 2005). All individuals are referred to by pseudonyms.

Table 3.1.

Demographic measures and self-reported dietary preferences of participants (n=10).

Participant ID*	Sex	Age (years)	Ethnicity	Self-reported dietary preferences.	Employment	ORTO-15 scores
Ebou	Male	32	Black African	Halal	Self-employed	27
Matt	Male	24	White British	None	Student/Career	41
Anna	Female	25	Other White	Vegan	Psychology Researcher	35
Em	Female	35	Other Asian	Vegan	Paralegal	33
Sarah	Female	29	Other Asian	Vegetarian	Model	41
Lynn	Female	24	Other White	Vegan with occasional addition of chicken.	Model	35
Silvia	Female	23	White British	Vegan with occasional consumption of eggs	Model	34
Elizabeth	Female	33	White British	None	Make-up artist	35
Rafaela	Female	27	Mixed	None	Retail (high end fashion brand)	29
Cat	Female	31	Other White	None	Model	31

Note: *Pseudonyms are used throughout

Recruitment. Recruitment strategy involved purposeful snowball sampling technique. Ten individuals were approached by the members of the research team and asked to participate in this study. An information sheet was given to all participants at the recruitment stage. As there are no formal diagnostic criteria for ON, the language used was neutral; there was no mention of ON. No exclusion criteria were applied by ethnic background, occupation, or sociodemographic status. Exclusion criteria included current presence or history of eating disorders or any other psychiatric diagnosis, inability to speak English, and age under 18 years.

Procedure. The present study was approved by the FREC. Eight interviews were conducted face-to-face in a location of the participant's choosing to ensure safety and confidentiality. Two interviews were conducted via Skype since participants were abroad at the time. Skype sessions followed the same format as in-person data collection sessions. At the beginning of each interview the disclaimer was read aloud to all participants that assured of confidentiality, encouraged to speak without fear of judgement, and outlined the intention to have a discussion about their personal experiences, reasons, motivation and feelings individuals assign to their relationship with food. Participants were also informed that the interviews were semi-structured and were encouraged to explore the topics as they felt comfortable to do. We emphasised participants' right to withdraw during the interview at any moment. Participants confirmed their consent verbally. Interviews were open-ended and audio-recorded; the average length was approximately one hour. Interview guides were designed based on the available published literature on ON (e.g. Brytek-Matera, 2012; Håman et al., 2015; Varga et al., 2013). Interviews explored the development of current eating practices, reasons for adherence to the diet of choice, influences of dietary practices on social and professional domains, and perceptions

and meanings assigned to the concept of a “healthy” diet. Participants were informed that all data would be anonymised and were asked to select a pseudonym to maintain their anonymity. Interviews were conducted and transcribed verbatim by the first author. Recruitment and data collection took place from June to September of 2018. Interviews were audio-recorded and produced 8.08 hours of recording, which were then transcribed verbatim for data analysis.

Participants were also asked to complete a battery of psychometric measures and provide 24-hour recalls of their dietary intake. The data from psychometric and nutritional assessments is published separately (Mitrofanova et al., 2020). This article reports only the analysis of the driving forces behind “qualitative attribute based” food restriction practices of participants.

Data Analysis. Thematic analysis technique as defined by Braun and Clarke (2006) was used to analyse the interview data. The hallmark of this approach is its flexibility as a method that may be used by researchers relying on various philosophical underpinnings. Qualitative interviews in this study were a part of a larger study which also assessed participants’ micro and macronutrients intakes and involved a battery of psychometric measures. The study was designed following a paradigm of pragmatism. This position suggests that ontological essence lies in actions and change; humans are actors in the constantly changing world (Goldkuhl, 2012). Pragmatism does not dictate or limit the use of different methods in research, but rather adopts a pluralistic position (Goles & Hirschheim, 2000). In this article, thematic analysis was used to not only describe the actions and cognitions of individuals, but also to understand the changing nature of reasons in a world that is in a state of constant becoming.

Thematic analysis was used inductively in this study without assigning preconceived notions of ON. The first author repeatedly read and familiarised herself with the full data set. Atlas.ti (ATLAS.ti Scientific Software Development GmbH) software was used for open thematic coding to identify concepts or “meaning units” according to the “bottom-up principle”. The next stage involved grouping the codes that were related based on their semantic and conceptual readings into sub-themes. Sub-themes were continually collapsed together to generate larger themes of the study. The final codes and sub-themes were reviewed and agreed upon with the second author.

Results

Four themes emerged from the data: “journey”, “rules/control”, “social”, and “ethical considerations”.

Journey

Participants in this study spoke about their journey to develop their current habits and beliefs about the chosen diet. The change for all individuals was gradual and was often described as a “transition”. For example Ebou explained:

I didn’t automatically just change, so I change my views on it and I started ordering fruit and veg from there [organic delivery company] because it tastes nicer and um... yeah, just since then started looking into it a bit more...

Several factors were indicated as key to initiating the transition. The first factor was described as re-evaluation of what was thought to be a healthy diet and acceptable food practices by participants’ families. This re-evaluation represented a change in cognition from “eat what’s on your plate” to exercising agency over food

choices. Individuals in this study, despite being residents of the UK at the time of data collection, came from various cultural backgrounds. For example, Lynn criticised her parent's beliefs for being based on outdated government guidelines:

They're such set ways like I think we been brought up with being told that you get strong and amazing and it's the only way, to drink milk for example, like my dad would have a large pint of milk and I think it looks bizarre, like bec.. but that's the way we've been brought up and I think a lot of it comes down to, like the welfare years in Sweden when they wanted to boost the whole milk industry um... so obviously they gonna tell the people, politicians are gonna tell people that milk is great.

Despite the very different cultural background, Em expressed a similar view about the difference in perceptions between generations: "I used to think vegans are maybe confused, maybe... because I just literally thought animals can be eaten and they are for us to use... that's my, you know, maybe that's the way of thinking inherited from previous generations." The gradual change in eating habits was informed by fluctuating eating patterns. Individuals indicated that they've tried several diets before settling on the current one. Lynn explained: "My interest has grown so much in five years, like more and more, more food and I think I've experimented a lot, I've done like raw vegan, I've done vegetarian, I've done um... now I'm like mainly vegan, at the moment I'm adding a bit of chicken and fish to get enough protein um... Yeah." The second factor indicated as a significant influence on individuals' journey was relocating to a different country. Participants experienced a lack of inhibition in their eating practices. Some, like Anna, abolished their restrictions consciously in order to experience the new culture: "I though I want to explore, like all the countries with everything they give and um... the food is also,

like very important part of the culture...” While others found themselves lost without familiar foods and defined their current diet as an attempt to take back control. For example, Rafaela explained:

I moved to London and I saw it as a... almost like a “Candyland”, everything was a temptation and there is so much sugar in everything here and you just... you are twenty and you think that you can just eat without suffering any consequences so... and sugar is addictive so you start eating sugar and then eating the sugar is now a problem and you feel weak and you know your skin is not good, but you know, you still don’t associate it with the sugar, you justify yourself because you want more of the shit, want to indulge more. So it took me... quite a long time... to identify the problem and... fix it.

Distrust towards ingredients in foods of the host country was implicated in increased scrutiny of food labels. In particular, sugar and corn sirup were among the additives that raised suspicion and resulted in increased restrictions of the foods suspected to contain those. Cat explained:

And pretty much, 95% they put in corn syrup. In everything like, in everything like that you know, you see pastries, or like, you know like different types of bread or like, popcorns, or whatever snacks. You know, you really have to look for it, and some of them, like um... um... the things that you wouldn’t expect sugar to be there, like rice... like rice cakes something which is normally should be just rice.

Finally, for most participants the onset of the change in cognitions about “healthy” could be traced to the influence of family, friends or social media. For

example, for Em it was a vegetarian friend who insisted on not socialising with meat eaters: “It was like a social thing, I knew she doesn’t like to see meat in front of her, so when I did go out with her, I didn’t eat meat.” Em also indicated a social media influencer as her inspiration for switching to raw food diet at a later stage. For other participants it was a family member: “... he told me, listen, it’s not a rubbish that you are used to. This is organic. Since then I started having nicer fruit and veg and I used to only have like brown rice organic... that was it” (Ebou). For Anna it was a yoga teacher that defined the appropriate diet. Interestingly, the rules adopted from the social circle resulted in a change in behaviour towards the social circle itself.

Social

This theme contains individuals’ elaborations about the impact of their chosen diet on day-to-day interactions and their social lives. Most of the participants acknowledged that prioritising their diet impacts people in their immediate social circle. Family members cook separate meals at family gatherings (e.g. Christmas). When eating out, participants’ views about the impact of their chosen diet differed. On one hand, individuals didn’t perceive any discomfort their diet might cause to their acquaintances. They expressed their diet to be an inseparable part of their identity and suggested that their friends were well informed of their dietary patterns and would not maintain the friendship if the social circle was not considerate of their requirements. On the other hand, some of the participants reflected that their eating habits had a negative impact on their social relationships. For example Cat suggested:

I mean psychologically it’s annoying. Even like to be on a diet what I found is that psychologically, socially it was difficult. You know? Because

like, you make a fuss all the time about what you can not eat. You're making an order in a shop, in a restaurant, in a bar, at a friend's place "Oh, I can't eat this. I can't eat that" and you know, when you... when people... of course first time people are fine with this but the second time people start making you comfortable and trying to offer you options, and because you can't eat anything you say no, no, no, no and this is how people start getting annoyed. You know? So... um... then you feel like you are difficult, you know?

Em felt like she was misunderstood by her immediate social circle: "people definitely talk, gossip at work, my mom probably thought some form of eating disorder, cause they don't understand." This theme is connected to the elaborations offered in the previous one (Journey). Social influences were prominent in descriptions of the onset of the dietary patterns and played a role in social relationships participants chose to form. For example, Anna mentioned that maintainng her diet is facilitated by the people she lives with: "I'm living in a shared living with two other girls and they are at least vegetarian too. So, at my home it's perfectly fine when we want to eat together. And when we go to restaurants it's quite easy as well, because there is always at least a salad or something." There was a notable disparity between the reported attitudes towards other people's dietary habits and the reported behaviour. For example, the previous quote points towards a behavioural choice of this participant to share accomodation with people following a similar diet but the general attitude reflected diet to serve a function of othering: "I know what I want for me, but I would never tell any other people how to behave or what to do, like people have to make their own experience and um... yeah. And if they... they have to live the way they want to and I am like this I make my own experiences and I feel better this way" (Anna). This reflects an attempt to situate

oneself as individual that claims respect for others' choices yet prefers to associate with people following a similar diet.

Rules/Control

Individuals reported following very specific set of rules in their diets. The four participants that identified as vegans differed in their descriptions of veganism. For example, Lynn, despite self-identification as vegan included chicken and fish in her diet, while Anna (also self-identified vegan) excluded garlic and onion from her diet. Explanations for these very particular rules also differed. Lynn explained that she included animal products because following a strict vegan diet has led to adverse health consequences (hair loss), while Anna explained that onions and garlic were excluded due to these foods' perceived antiseptic properties.

Um... because there are some substances in... in these um... that are... yeah... a little bit like antibiotic so they are... they have influence like in the body, you know people say that it's a good influence but I want to keep my um... my body as natural as possible. That I don't kill anything in my body because if I... if I... kill some bacteria that is bad I always also kill bacteria that's good. So I... um... so I try to really keep my body as natural as possible.

Some foods were described as “disgusting” and “dirty”. These included processed foods, products with “diet” and “low fat” labels, foods containing preservatives, chocolate, dairy, foods containing added sugar, and ready-made-meals. Homemade meals were described as “cleaner food”. Interestingly, despite the list of dietary restrictions individuals suggested that too much control was unhealthy. “I think it's also unhealthy to be too controlling about what you eat” (Silvia).

The rigid control over diet spilled over onto individuals' choices of work, holiday destinations and places of residence. For example, Matt described his choice of part-time work as carer to be beneficial to his ability to maintaining the strict meal times.

That job helps my... my eating patterns and stuff, because I have... I do like morning, afternoon, and evening shifts. I do it every single day. So, like, yesterday I had a full day. So I worked from 7 to 11 [am], and then I had from 11[am] to 1 [pm] off, so that was my period time to eat, so... so... I'll eat before... I'll eat after I get back, so I'll eat nothing in the morning, I wake up, get back at 10 or 11, I'll eat then, and then I'll go back at 1 [pm] and stay until half two, eat at half two and then I'll go back at 5 [pm] and I'll eat at 5 before I go and I'll be out until 10[pm]. My job actually helps, it helps me eat more than... if I did a full time job where you work from 8 to about half five, they are not gonna be happy with me stopping every 3 hours to eat, so this job is probably better for me.

Other participants chose their holiday destinations based on the local foods of the country. Places of residence were chosen based on the vicinity of parks to maintain the exercise routine. Most of the individuals were physically active. Even though the degree of importance placed on physical activity varied, all ten individuals were very specific about the type, intensity, and duration of their exercise sessions. For most (except Ebou), physical activity helped to achieve or maintain a particular body shape. Matt was exercising to "get bigger", Cat and Silvia took ballet classes to maintain a lean body shape, while Sarah engaged in long distance running for the same reason. Physical activity was instrumental in motivation to control physical appearance. In addition, individuals implicated their body as an indicator of

what healthy is. “If your body is happy, then, you know, I think that is like... healthy” (Lynn). Participants indicated that the body is an entity that needs to be listened to and be taken care of “listen to your body I guess, and see how the body reacts” (Cat).

Ethical considerations

Ethical considerations for the environment, food production practices and animal welfare played a key role in maintenance of the dietary restrictions. Individuals defined themselves as supporters of ethical food producers. This theme is related to a change in participants’ perceptions described earlier in “Journey”. In particular, food was perceived as something that needs to be consumed in order to survive, not something to enjoy. Em mentioned that “killing animals is like selling your soul” and further explained that adding an ethical dimension to the reasons for following her diet made it easier to avoid transgressions.

When you change for ethical reasons it is a really strange question because like a... why do I miss killing animal? You know? I mean when I became for social reasons or health reasons, yeah! I did miss the taste of meat. But then when now, because I changed like... my perception has changed because of watching all this vegan content.

Four participants reported to follow a vegan diet, one individual was vegetarian and one participant adhered to a halal diet. Although it was acceptable for social acquaintances not to share the same values as participants regarding food, ethical concern for food production was a common characteristic between the varying diets. For example, Ebou followed the tradition of his Muslim faith and elaborated:

Different people kill it [animal] in different ways, so if you sort of tase an animal and then kill it that way, the actual animal blood won't drain properly, so that's the whole point in sort of sacrificing it in a certain way because the blood all comes out from the shock and adrenaline, it sort of... it's a much cleaner way of killing that animal.

Rafaela expressed distrust about the food's journey from producers to the market shelf: "everything needs to be organic, I know where it comes from, I can source it and have the insurance that my food has not been tampered with".

Motivation for eating "healthy" was grounded not only in a strive for purity and particular body shape, but also in desire to minimise harm to animals and to support producers that are transparent with consumers about their practices.

Discussion

This article presents an analysis of experiences and views of individuals with possible ON. Participants were encouraged to speak at length about their food choices and the reasons for adherence to the chosen diets. We aimed to explore their cognitions to better understand the development of this elusive condition. Consensus on development of recognised eating disorders is that the causes are complex and multifactorial (Polivy & Herman, 2002), while little is known about the development of possible ON. The first theme presented in this article (Journey) reflected the participants' perceptions of the factors that contributed to their current dietary status. Particularly interesting were the perceptions of what healthy eating meant to the individuals. Healthy eating was perceived as an assertion of "agency" over individuals' lives. Agency can be described as how strongly a person believes he or she can have an impact on experiences and behaviours and has been suggested to

influence success of psychotherapeutic treatment for established eating disorders (Kristmannsdottir et al., 2019). Participants in this study described the development of their eating preferences as an attempt to establish independence from their family's beliefs about food and as a mechanism to assert control over their lives in times of change (e.g. moving to another country). The strive for control is not uncommon among individuals with eating disorders. For example, a cognitive behavioural theory of AN suggests that the extreme need to control food consumption stems from perceptions of failure in other aspects of one's life (Fairburn et al., 1999). In this case, control over eating provides individuals with immediate evidence of successfully executed behaviour and overall self-control that may be more difficult to obtain in other areas (e.g. work, relationships). Indeed, ON has been suggested to represent a coping behaviour in patients with AN (Barthels et al., 2017). It could be that the strive for control is similar in these eating pathologies where control over the quantity of consumed food shifts to its quality. It is unclear whether this shift in cognition is beneficial to treatment of AN, more research is needed.

Several participants in this study were involved in an occupation (fashion models) that places great value on one's physical appearance. Despite the fact that the proposed diagnostic criteria for ON mention weight loss only as a secondary outcome (Dunn & Bratman, 2016), participants stated that maintaining a particular body shape was one of the reasons for adherence to a self-defined healthy diet. For these individuals the strive for control over eating may have been further reinforced by the fact that their professional success is directly dependent on their appearance. In fact, healthy eating and physical activity were described as means to achieve and maintain the desired physique. Like dancers and athletes, fashion models are

considered to be a group prone to disturbances in eating behaviour (Treasure et al., 2008). After years of use of clinically underweight models in the fashion industry, several countries adopted restrictions on employment of individuals with Body Mass Index below 18kg/m^2 in an attempt to tackle eating disorders (Sykes, 2017). However, it is not known whether placing these restrictions has led to any changes in eating disorder rates in this population. This might, however, have had an impact on the image individuals involved in the industry attempt to convey to the rest of the society. Stereotypes attributed to individuals with eating disorders are well explored. With society's eye on the fashion industry as the breeding ground for eating pathologies, involved individuals might be motivated to present themselves in a favourable light and avoid self-descriptions that would compromise their image, and a healthy diet could be a socially acceptable way to justify their dietary restrictions. Vartanian (2015) suggested that adherence to a particular diet can be used to create a particular impression on others based on the stereotypes associated with certain eating behaviours. The assertion of our participants to follow a "healthy diet" can be viewed as an attempt at impression-management based on their food consumption. Early research on consumption stereotypes suggested that the amount of food eaten affects people's perceptions of eater attractiveness and gender role (Chaiken & Pilner, 1987). Furthermore, people consider eaters of "good food" more likeable, feminine, and attractive (Steim & Nemeroff, 1995). With this in mind, eating behaviours reflective of possible ON can be adopted to transmit a particular image that goes beyond what one eats and positions one as a person that stands for ethical practices in food production and advocates for animal welfare, which was reflected in reasons (ethical considerations) individuals in this study provided for their dietary behaviours.

All participants in this study talked about the social influences on the development of their dietary patterns. The similarity of the accounts lays in the fact that the inspiration for the change has come from participants' families and acquaintances and was further reinforced by social media influencers, literature on popular diets, and documentary films about animal welfare. Similar findings were observed in a recent study by McGovern et al. (2020). Individuals' change towards ON tendencies was initiated by reading articles about nutrition on the internet, and was influenced by health professionals and families. Proposed diagnostic criteria for ON (Cena et al., 2019) state that this condition has a negative impact on individuals' social lives and may lead to isolation. Participants in this study, however, did not report feelings of isolation due to their dietary restrictions but preferred to socialise with people following similar diets. Social influence in the context of eating behaviour has been extensively studied (e.g. Robinson, 2015). For example, people tend to consume less food when dining with someone eating very little (Roth et al., 2001). The complexity of eating behaviour emerges from the fact that it is not only reliant on hunger and satiety, but represents a social ritual in many cultures. In order to partake in social rituals people can model their behaviour to match the perceived social norm. Individuals' preference to socialise with people who adhere to similar dietary restrictions can lead to creating new social norms among a segregated group of people and promoting a sense of belonging. Dunn and Bratman (2016) observed a trait that is not included in the diagnostic criteria but might be helpful in identifying ON cases, which is the moral judgement of others based on their diets. This was characteristic of some of the accounts offered in the current study. However, the same concept has been discussed in relation to vegans and vegetarians suggesting that adherents to these diets use it to justify moral superiority over others (Kroeze,

2012). Five individuals in this study reported to adhere to vegan/vegetarian diets. Therefore, it is not surprising that the accounts reflect moral overtones related to social relations and ethical considerations.

BRT aims to understand and predict behaviour and suggests that while the likelihood of an occurrence of a certain behaviour relies on intentions, global motives, beliefs and values held about this behaviour, reasons for and against represent a key dimension (Westaby, 2005). The beliefs and values of our participants were reflected across two themes, journey and ethical considerations. Interestingly, this study shows the change in beliefs about food from the values held by participants' family's to the new ones reflecting personal autonomy. Through the lens of the BRT, reasons motivate and justify behaviour and help people to enhance or protect their self-worth (Westaby, 2005). Reasons individuals in this study provided for adherence to their diet are distributed across all four themes. The variety of justifications provided contribute to the difficulty defining ON. The strive for a healthy diet was motivated by social influences, desire for control during life changes, concerns for ethical food production, animal welfare, weight maintenance, and moral undertones. One component that did not perform as predicted by the theory was "subjective norms". Subjective norms represent social pressure from significant others to engage in a behaviour. In this study, subjective norms were not cited as a reason for our participants' behaviours. Participants chose to surround themselves with individuals following similar dietary restrictions thus creating new subjective norms that suited their own behaviour.

Our study aimed to contribute to the understanding of ON and to explore individuals' experiences of this phenomenon. Existing qualitative explorations of ON framed this condition as a socially constructed phenomenon and highlighted

moralistic hues assigned to food consumption among people self-identifying with excessive preoccupation with healthy eating (Cinquegrani & Brown, 2018; Fixsen et al., 2020). Fixsen et al. (2020) further suggested that caution should be exercised in advocating recognition of ON as a stand-alone disorder and its inclusion into the DSM-V (American Psychiatric Association, 2013) because of the risk of medicalising a lifestyle choice. Individual accounts in this study have also highlighted moral discourse about food production and animal welfare. However, the current study is the first to identify that a preoccupation with appearance, strive for control and social aspects of participants' lives contribute to adherence to self-defined healthy diets indicative of ON.

A primary limitation of this study is the fact that there are no officially recognised diagnostic criteria or tools for ON. In this study, participants were selected on the basis that they exhibited behaviours and attitudes reflective of possible ON. However, given the lack of tools, no study, including the present one, can claim to have investigated a sample of individuals diagnosed with this condition. Recruitment was therefore based on the behavioural observations reported by participants and considered, on the basis of the available evidence, to reflect possible ON. Participants also completed a number of psychometric measures and provided 24-hour recall of their nutritional intakes, which are presented in the section 3.2 of this thesis. Of note are the scores on ORTO-15 questionnaire. Scores of eight participants were indicative of orthorexic tendencies while two participants scored just above the cutoff point, which further indicates the presence of possible orthorexic behaviours among this sample.

Another limitation was that men were underrepresented in this study. Including a more balanced sample would provide an opportunity to explore gender

differences of ON experiences. In the future, studies should focus their efforts on finalising a robust definition of the condition and developing a diagnostic tool, which would facilitate identification of participants for future research. Qualitative studies such as this one, which have explored the experience of individuals following a restricted diet, will facilitate in this development. In line with existing research, the present study (McGovern et al., 2020) discovered social influences as an important domain in development of ON tendencies. Future studies should explore this in more detail. It would be particularly informative to explore whether ON, like established eating disorders, runs in families.

Conclusion

In line with previous qualitative explorations, external social influences were described as a source of ON tendencies, yet social isolation resulting from dietary choices was not reported in this study. Participants preferred to socialise with those who shared their dietary preferences, suggesting ON to play an organising rather isolating role in their lives. In addition, control and choices of a particular dietary intake manifested the need of establishing agency and identity particularly in times of changing personal circumstances. This study also suggests that reasons for adhering to a “healthy” diet are far more complex than a desire for purity, which is commonly assumed in the ON literature. Further explorations of reasoning behind food choice will aid in establishing whether this condition can be classified as a pathology.

3.2 Study 2. “Assessing psychological and nutritional impact of suspected orthorexia nervosa: A cross-sectional pilot study.”

Abstract

Background. To date research on the dietary patterns of individuals with potential orthorexic symptoms is lacking. This cross-sectional pilot study aimed to explore the feasibility of assessing dietary patterns with psychological traits and states of individuals with possible orthorexic tendencies.

Methods. Dietary intakes of 10 individuals (two males and eight females) were assessed using 24-h recalls. Mean age of participants was 28.3 years; mean body mass index was 21.2 kg/m². Nutrient intakes were compared with current dietary guidelines and the Eatwell Guide (Public Health England, 2016). Participants completed the ORTO-15, the Eating Attitude Test (EAT-26), the Obsessive-Compulsive Inventory-Revised edition (OCI-R), Paulhus's Spheres of Control (SoC), the Rosenberg's Self-Esteem Scale (RSES) and the Multidimensional Body-Self Relations Questionnaire (MBSRQ).

Results. High levels of disparity across participants' psychometric scores and 24-h recall results were observed. There was no single pattern of self-imposed dietary restrictions among participants. Described dietary practices failed to meet the guidelines for several nutrients.

Conclusions. The results of this pilot study suggest that an extensive investigation of the diets of individuals with possible orthorexic tendencies in a large-scale study would contribute to the understanding of this condition. In addition, the use of multiple psychometric instruments is recommended for diagnosing orthorexia nervosa.

Introduction

Orthorexia nervosa (ON), referring to a pathological obsession with clean or healthy nutrition was coined by Bratman in 1997 (Bratman, 1997). According to

proposed diagnostic criteria (Cena et al., 2019; Dunn & Bratman, 2016), those with possible ON display restrictive dietary practices aimed at maximising health, which escalate over time potentially leading to social isolation and malnutrition.

Transgression of self-imposed rules on food intake results in guilt, anxiety and subsequent compensatory behaviours such as stricter restrictions or “cleanses”.

Engaging in compensatory behaviours, individuals attempt to rid themselves of the substances perceived as impure.

Although there is growing attention to ON in the academic and popular media (Vandereycken, 2011), there is no current consensus on whether the disorder exists, and diagnostic criteria have not been established (Cena et al., 2019). ON is not listed in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.) (American Psychiatric Association (APA), 2013). However much research has been conducted subsequently.

The majority of existing research on ON has focused on identifying prevalence in different populations (Almeida et al., 2018; Alvarenga et al., 2012; Asil & Sürücüoğlu, 2015; Bağcı Bosi et al., 2007), adapting the diagnostic questionnaire in different countries (Andreas et al., 2018; Brytek-Matera et al., 2014; Moller et al., 2019), examining potential links to other eating disorders (Brytek-Matera et al., 2015; Koven & Abry, 2015), and identifying whether ON may be a variant of obsessive-compulsive disorder (OCD) (Koven & Senbonmatsu, 2013). Studies have identified similarities between ON, OCD and disordered eating (Asil & Sürücüoğlu, 2015; Hayes et al., 2017; Oberle et al., 2018; Segura-Garcia et al., 2015; Tremelling et al., 2017). Dieting, among a range of psychosocial factors such as perfectionism, poor body image and drive for thinness, was also found to be positively associated with ON (McComb & Mills, 2019). The recent thinking on ON

suggests that despite existing evidence of social impairments and changes in emotional, cognitive and behavioural functioning, labelling ON as a distinct mental illness should be carried out with caution because it is challenging to distinguish between the conscious control of dietary intake and pathological behaviour when both are aimed at achieving a healthier diet (Strahler & Stark, 2020).

Diets of patients suffering from recognised eating disorders such as Anorexia Nervosa (AN) have received considerable academic attention (Hadigan et al., 2000; Pinkston et al., 2001; Raatz et al., 2015), and the importance of including nutritional interventions in treatment programs is recognised (Ozier et al., 2011). By contrast, studies of ON have focused on psychological aspects of eating behaviours and reported on the eating behaviours of various groups following specific diets. The majority of such studies have explored whether vegetarian or vegan individuals were at increased risk of developing orthorexic tendencies (Herranz Valera et al., 2014). Although they have used the same scale to measure ON (Donini et al., 2005), the findings have been inconsistent. Those who followed vegetarian/vegan diets demonstrated greater orthorexic tendencies than those who did not in a sample of Italian students (Dell’Osso et al., 2018), whereas the opposite was shown among American students (Dunn et al., 2017). Other studies did not find higher rates of ON in vegetarians/vegans compared to omnivores and those following paleo diets (Tremelling et al., 2017). However, such studies only assessed dietary intake by asking whether participants adhered to vegetarianism/veganism using a questionnaire.

One study to date that we are aware of has measured the nutritional composition of orthorexic diets in a sample of Greek dietetic students (Grammatikopoulou et al., 2018). Data were gathered via an online 3-day food diary.

Students identified as having ON consumed less energy and saturated fatty acids than non-orthorexic students. These results should be cautiously interpreted because Bratman's Orthorexia Scale (BOT) (Bratman & Knight, 2000) was used to identify ON. Whilst BOT was the first measure developed by Bratman based on ON characteristics observed in patients, it is not a recognised clinical diagnostic tool.

People identified with ON are known to exclude foods perceived as lacking purity or considered harmful to health (Cena et al., 2019). Research to date has not focused on understanding which food groups are excluded from the diet, nor the reasons for their exclusion, and so the implications of dietary restrictions in ON are unclear. Examining the dietary intake of individuals with possible ON could enhance our understanding and shed light on the eating patterns of this population.

The present pilot study is part of a larger study, which focuses on possible overlaps between ON and other conditions, and the dietary intake of individuals displaying orthorexic tendencies. This pilot study explored the feasibility and utility of simultaneously exploring dietary practices and psychological traits and states of individuals with possible orthorexic tendencies. Alongside the qualitative interviews, participants completed a psychometric assessment and reported their dietary intakes, which formed the basis for this study. It aimed to explore whether there were possible commonalities in restrictive dietary practices between individuals in the context of their lives, as well as to investigate possible implications of dietary restrictions by comparing their intakes with recommendations.

Materials and methods

This exploratory pilot study used mixed-methods as detailed below. Ethics approval was granted for this project by the FREC.

Participants. Only participants aged at least 18 years were eligible. No exclusion criteria were applied by ethnic background, occupation, or socio-demographic status. Participants were known to the research team from personal and professional contacts (six individuals employed in the fashion industry, one student on nutrition and sports science degree, one participant employed as a psychology researcher and one person recommended by the participants based on their similar eating restrictions). They exhibited dietary restrictions reflective of possible ON symptoms as defined by Dunn and Bratman (Dunn & Bratman, 2016) (e.g. beliefs that some foods compromise the “purity” of their body, obsessive preoccupation with consuming only “healthy” foods, sense of self-worth reliant on compliance with the diet of choice). Participants reported that there was little day-to-day variation in their dietary intakes. As there are no officially recognised diagnostic criteria or diagnostic instruments, recruitment was based on research team’s observations of participants’ eating behaviours and attitudes.

Procedures. Participants were recruited using purposeful snowball sampling techniques. Ten individuals were approached, and all agreed to participate in the study. An information sheet was provided to all participants at the recruitment stage and the language used was neutral; ON was not mentioned (see Supporting information, Appendix 3).

Data collection

A three pronged approach was employed for data collection. Data collection sessions consisted of (i) semi-structured audio-recorded interviews to collect

qualitative data and to ask about psychological conditions including eating disorders; (ii) 24-h recalls to assess dietary intakes; and (iii) psychometric measures. Eight sessions were held face-to-face, whereas two sessions were conducted via Skype (<https://www.skype.com/en>) because participants were abroad at the time. Skype sessions followed the same format as in-person data collection sessions. The whole data collection process took approximately 2 h per participant. The data analysis of the driving forces behind “qualitative attribute based” food restriction practices of participants will be published separately. Qualitative data were used only for context in the present study, which focuses on 24-h recall data and psychometric assessments.

Measures. Participants self-reported their heights and weights from which body mass index (BMI) was calculated (World Health Organization, 1995) .

Dietary intake

During the interview, participants were asked to report whether they followed any specific diets (e.g. vegetarianism), and the extent of day-to-day dietary variation. All participants indicated that they rigidly followed the same patterns every day. Consequently, nutritional intake was assessed via in-person 24-h dietary recall interviews. Participants were asked to recall all the foods and drinks consumed in the previous 24 hours, followed by checking questions to clarify food preparation methods and detail about additional ingredients in foods and beverages (e.g. milk and sugar in drinks, herbs and spices in meals). Participants indicated the portion sizes of the foods/drinks consumed using photographs of different portion sizes (Nelson et al., 1997). Data were entered into “Dietplan 7” (Forestfield Software Ltd, Horsham, UK), which generated individual reports of macro and micronutrient intakes.

Psychometric measures

A questionnaire was compiled of a battery of psychometric assessments based on previous research (Barnes & Caltabiano, 2017; Brytek-Matera, Donini, et al., 2015; Koven & Senbonmatsu, 2013; Segura-Garcia et al., 2015). Eight participants completed this on paper after the nutrition interview, whereas two were provided with an online link using Surveymonkey.com after their interviews via Skype.

Assessment of orthorexic tendencies

For identifying the possible presence of ON, participants completed the English version of the ORTO-15 (Donini et al., 2005) questionnaire. However, participant selection did not rely on completion of ORTO-15; in the present study, it was used to identify possible orthorexic tendencies in participants, not as a diagnostic tool. At the time of ethics application and data collection, it was the only questionnaire widely available. Despite limitations, it is used in the majority of studies to identify those with ON (Valente et al., 2019). It consists of 15 items with responses based on a four-point Likert rating scale. Scores below 40 indicate orthorexic tendencies (Donini et al., 2005).

Assessment of potential problematic eating patterns

Participants completed the Eating Attitude Test (EAT-26) (Garner et al., 1982), a standardised psychometric measure to identify symptoms characteristic of eating disorders. It comprises 26 items forming three subscales: dieting, bulimia and food preoccupation, and oral control. A score above 20 suggests a possible risk of eating disorder.

Obsessive-compulsive tendencies

Potential overlaps between ON and OCD were assessed using the Obsessive-Compulsive Inventory-Revised (OCI-R) (Foa et al., 2002). This consists of 18 statements assessing six common OCD symptoms, each scored on a five-point Likert rating scale. A score at or above 21 indicates the presence of OCD (Foa et al., 2002).

Control

Perceived locus of control was assessed with the personal control subscale of the Paulhus Spheres of Control scale (Paulhus, 1983). This subscale consists of 10 statements with seven-point Likert-type ratings measuring beliefs about levels of control people have over their lives. Scores below the normal range (<43.1) indicate feeling less in control than the average person, whereas scores above the normal range (>59.7) signal feeling more in control than average.

Self-esteem

The Rosenberg Self-Esteem Scale (RSES) (Rosenberg, 1965) consists of 10 items with 4-point Likert-type rating. Scores <15 indicate low self-esteem.

Body image

Body image perceptions were examined using the Multidimensional Body-Self Relations Questionnaire (MBSRQ) (Cash, 2015). This 69-item questionnaire contains nine subscales: appearance evaluation, appearance orientation, fitness evaluation, fitness orientation, health evaluation, health orientation, body areas satisfaction, overweight preoccupation and self-classified weight. There are no cut off scores (author-provided population averages for each subscale are used).

Statistical analysis

Individual macro and micronutrient intakes generated by “Dietplan 7” were compared to national age and gender-specific recommendations (DoH, 1991;

Scientific Advisory Committee on Nutrition, 2011, 2015, 2019) and to the Eatwell Guide (Public Health England, 2016). All scores were treated individually; inferential statistics were not used due to the small sample size in this pilot study.

Results

Eight females and two males participated, with mean (SD) ages of 28.4 (4.37) years and 28 (5.66) years, respectively. All participants were part-time or full-time employees. No participant reported a history of or current psychological conditions or eating disorders. Anthropometric data of the 10 participants are shown in Table 3.2. Four individuals had a BMI below the healthy range (18.5-24.9kg/m²) and one had a BMI of 27.2kg/m² in the overweight range.

Table 3.2

Anthropometric measures and self-reported dietary preferences of participants

(n=10).

Participant ID*	Sex	Age (years)	Height (m)	Weight (kg)	BMI (kg/m ²)	Self-reported dietary preferences.
Ebou	Male	32	1.89	88	24.6	Halal
Matt	Male	24	1.83	91.7	27.2	None
Anna	Female	25	1.79	58	18.1	Vegan
Em	Female	35	1.60	54.9	21.4	Vegan
Sarah	Female	29	1.73	51	17	Vegetarian
Lynn	Female	24	1.78	54	17	Vegan with occasional addition of chicken.
Silvia	Female	23	1.68	49	17.4	Vegan with occasional consumption of eggs
Elizabeth	Female	33	1.71	57	19.5	None
Rafaela	Female	27	1.65	57	20.9	None
Cat	Female	31	1.76	57	19	None

*Pseudonyms are used throughout

Scores for psychometric measures are shown in Table 3.3.

Table 3.3.

Individual results from the psychometric measures.

Participant ID	ORTO-15	EAT26	RSE	OCI-R	SoC	MBSR Q-AE	MBSR Q-FE	MBSR Q-HE	MBSR Q-AO	MBSRQ -FO	MBSR Q-HO	MBSR Q-IO	MBS RQ-OWP	MBSR Q-SCW	MBS RQ-BASS
Ebou	27	17	27	20	70	5	4.80	5	4.25	3.83	4.86	1.20	1	3	5
Matt	41	19	23	11	56	3.71	2.60	4	3.33	3.67	3.43	3.40	2.50	3.50	3.11
Anna	35	2	30	6	63	4.71	4.60	3.67	3.67	3.92	4.29	3.60	3	3	4.56
Em	33	1	28	21	56	3.57	3.20	3.33	2.58	2.58	4.00	3.40	1.75	3	3.44
Sarah	41	14	15	17	52	3.14	3.80	3.50	3.58	3.58	4.14	3.80	3	3.50	2.78
Lynn	35	6	24	17	49	4.57	3.80	3.17	3.92	3.67	4.29	4.20	1.25	2.50	4.22
Silvia	34	10	21	15	40	3.29	3.20	4.33	4.42	3.33	4.00	2.80	2.50	3	2.89
Elizabeth	35	4	21	10	46	3.43	3.20	3.33	3.25	3.25	4.00	3.60	2.25	3	2.78
Rafaela	29	22	20	13	57	3.86	2.60	4	4.33	2.83	3.43	3.40	3.50	3.50	3.44
Cat	31	4	27	14	54	4.14	5	4.17	4.25	4	3.29	2.60	1	2.5	4.56

Note: Values in bold indicate problem scores for individual tests. *ORTO-15* (Donini et al., 2005). Cut-off scores of 40 and 35 were employed in this study. Scores <40; <35 indicate presence of ON. *EAT-26* Eating Attitudes Test (Garner et al., 1982). Scores above 20

indicate presence of disordered eating attitudes. *RSES* Rosenberg Self-Esteem Scale (Rosenberg, 1965). The scale ranges from 0-30. Scores between 15 and 25 are within normal range; scores below 15 suggest low self-esteem. *OCI-R* Obsessive-Compulsive Inventory-Revised (Foa et al., 2002). Cut-off score is 21, with scores at or above this level indicating the likely presence of OCD. *SoC* Paulhus Spheres of Control Scale (Paulhus, 1983). Scores below the normal range (<43.1) indicate feeling in less control than the average person; scores above the normal range (> 59.7) indicate feeling in more control than the average person. *MBSRQ* Multidimensional Body-Self Relations Questionnaire (Cash, 2015): *MBSRQ-AE* Multidimensional Body-Self Relations Questionnaire Appearance Evaluation subscale assesses feelings about physical appearance; higher scores indicate greater satisfaction with appearance, *MBSRQ-FE* Multidimensional Body-Self Relations Questionnaire Fitness Evaluation subscale assesses feelings of being physically fit; high scores indicate person's belief of being "in shape", *MBSRQ-HE* Multidimensional Body-Self Relations Questionnaire Health Evaluation subscale assesses feelings of physical health; high scores indicate belief that one's body is in good health and is free from illness, *MBSRQ-AO* Multidimensional Body-Self Relations Questionnaire Appearance Orientation assesses investment in appearance; higher scores indicate more importance and attention placed on looks and more engagement in grooming activities, *MBSRQ-FO* Multidimensional Body-Self Relations Questionnaire Fitness Orientation subscale assesses the extent of investment in fitness level or athletic competence; high scorers value fitness and are actively involved in activities to enhance or maintain their fitness, *MBSRQ-HO* Multidimensional Body-Self Relations Questionnaire Health Orientation assesses the extent of investment in healthy lifestyle; high

scorers are health conscious and try to lead healthy lifestyle, *MBSRQ-IO* Multidimensional Body-Self Relations Questionnaire Illness Orientation assesses the extent of reactivity to being or becoming ill, *MBSRQ-OWP* Multidimensional Body-Self Relations Questionnaire Overweight Preoccupation assesses one's fat anxiety, weight vigilance, dieting, and eating restraint, *MBSRQ-SCW* Multidimensional Body-Self Relations Questionnaire Self-Classified Weight reflects how one perceives one's weight, *MBSRQ-BASS* Multidimensional Body-Self Relations Questionnaire Body Areas Satisfaction assesses satisfaction with discrete aspects of one's appearance, high composite scorers are generally satisfied with most areas of their body.

The internal consistency reliability of the scores of ORTO-15 in the present study was found to have a low Cronbach's alpha score of 0.50. McDonald's omega coefficient was 0.62. However, these coefficients should be interpreted with caution because of the small sample size. Eight of 10 individuals scored within the orthorexic range (scores <40). The scores of the remaining two were just above the cut-off point. Results for other psychometric tests were more diverse. Only one participant exhibited eating patterns that suggested disordered eating as identified by EAT-26. Similarly, only one individual had a score indicating the presence of obsessive-compulsive symptoms.

All participants reported normal to high levels of perceived self-esteem on the RSE scale (i.e. scores of 15-30). Only one had a score indicating feeling less in control than average, according to the Paulhus's SoC scale.

Four individuals reported adhering to veganism, one to vegetarianism, and one followed a halal diet. The remaining four individuals did not adhere to any specific diets. However, the four vegan participants had anomalous descriptions of veganism; three reported regularly consuming foods normally excluded by vegans (e.g. eggs, chicken). All participants indicated high levels of rigidity in their daily diets with little individual day-to-day variation. However, none of the participants reported feeling distressed as a result of adherence to their diets.

Table 3.4 presents specific nutrient intakes of participants' compared with current dietary guidelines ((DoH), 1991; Scientific Advisory Committee on Nutrition, 2011, 2015, 2019).

Table 3.4.

24-hour recall assessments compared to the reference nutrient intakes and estimated average requirements.

Participant	Energy intake (kcal)	Protein (g) (%)	Carbohydrate (g) (%)	Fat (g) (%)	Trans fats (g)	SFA (g)	MUFA (g)	PUFA (g)	Fibre (g)	Iron (mg)	Calcium (mg)	Vitamin B12 (ug)	Folate (ug)	Vitamin C (mg)	Vitamin A (ug)	Zinc (mg)
Ebou	1125	<u>79.3</u> 27.7%	143.6 47.1%	29.8 23.5%	0.54 0.43%	7 5.6%	13 10.4%	4.2 3.36%	9.8	3.57	148	<u>3.3</u>	101	<u>63</u>	138.8	5.56
Matt	2142	157.7 28.5%	166.5 28.2%	98.3 40%	2.02 0.85%	24.9 <u>10.46</u> %	39.2 16.47 %	22.2 9.33%	35.2	17.38	532	7.8	497	684	1696.7	18.27
Anna	1721	50.1 11.4%	204.8 43.6%	83.7 42.8%	0.10 0.05%	24.2 <u>12.66</u> %	35.8 18.72 %	19.7 10.30 %	19.5	10.11	565	1.4	207	73	204.8	7.23
Em	1330	37.8 10.8%	252.3 67.3%	26.1 16.7%	0.01 0.007 %	3.7 2.5%	12.5 8.46%	6.5 4.4%	37	10.90	391	-	201	477	973.2	4.14
Sarah	2118	74 13.6%	292.8 50.6%	80.8 33.5%	0.39 0.17%	17.4 7.39%	38.7 16.44 %	16.2 6.88%	25.3	9.92	970	5.4	313	177	163.3	6.47
Lynn	2183	51.9 9.3%	349.7 58.8%	74 29.8%	0.07 0.03%	21.4 8.82%	29.6 12.2%	9.5 3.92%	23.7	8.85	245	-	183	167	423	8.73
Silvia	839	20.9 8.9%	170.5 68.1%	19.1 18.3%	0.01 0.01%	10.4 <u>11.16</u> %	5.6 6.01%	1.6 1.72%	22	6.28	259	-	260	154	1516.8	3.29
Elizabeth	2035	<u>79.3</u> <u>34.4%</u>	250.9 44.3%	81.3 14.9%	0.01 0.004 %	20.1 8.89%	29.2 12.91 %	14.5 6.41%	43.4	18.41	634	0.2	359	134	2335.2	13.14

Table 3.4. Continued.

24-hour recall assessments compared to the reference nutrient intakes and estimated average requirements.

Participant	Energy intake (kcal)	Protein (g) (%)	Carbohydrate (g) (%)	Fat (g) (%)	Trans fats (g)	SFA (g)	MUFA (g)	PUFA (g)	Fibre (g)	Iron (mg)	Calcium (mg)	Vitamin B12 (ug)	Folate (ug)	Vitamin C (mg)	Vitamin A (ug)	Zinc (mg)
Rafaela	1424	<u>65.5</u> 18%	174.4 45%	47 29%	0.85 0.54%	<u>20.2</u> <u>12.77</u> %	17.5 11.06 %	4.7 2.97%	13.2	8.41	540	<u>3.2</u>	134	9	253.7	9.90
Cat	842	36.4 17%	119.4 52.2%	27.5 28.8%	1.28 1.37%	15.4 <u>16.46</u> %	7.5 8.02%	1.8 1.92%	8.4	3.04	479	1.9	55	9	279.5	4.62
RNI men	2772 ^a 2749 ^b	55.5 15%	50% ^e	35% ^d	<5g/d 2% ^d	<10% ^f	12% ^d	6% ^d	30 ^d	8.7 ^d	700 ^d	1.5 ^d	200 ^d	40 ^d	700 ^d	9.5 ^d
RNI women	2175 ^c	45 15%	50% ^e	35% ^d	<5g/d 2% ^d	<10% ^f	12% ^d	6% ^d	30 ^d	14.8 ^d	700 ^d	1.5 ^d	200 ^d	40 ^d	600 ^d	7.0 ^d

Note: RNI Reference Nutrient Intakes. SFA Saturated Fatty Acids. MUFA Mono-unsaturated fatty acids, PUFA Poly-unsaturated fatty acids.

^aEstimated Average Requirement (EAR) values for men 19 to 24 years old (Scientific Advisory Committee on Nutrition, 2011).

^bEstimated Average Requirement (EAR) values for men 25 to 34 years old (Scientific Advisory Committee on Nutrition, 2011).

^cEstimated Average Requirement (EAR) values for women 19 to 34 years old (Scientific Advisory Committee on Nutrition, 2011).

^dDietary Reference Values for fat and nutrients ((DoH), 1991).

^eEstimated Average Requirement (EAR) value (Scientific Advisory Committee on Nutrition, 2015).

^fDietary reference value for saturated fats (Scientific Advisory Committee on Nutrition, 2019).

Highlighted values are below the RNI. Underlined values are above the RNI.

Reported diets of nine out of ten participants indicated inadequate energy and calcium intakes. Eight of 10 individuals reported low intakes of fat and iron whereas intakes of saturated fatty acids exceeded recommendations for five individuals.

Participants' dietary intakes were also compared with the Eatwell Guide, to identify whether there were commonalities in restriction of particular food groups (Public Health England, 2016). No single pattern of deviation from the recommendations was found apart from the majority of participants reporting very low intakes in the "dairy and alternatives" category (Table 3.5).

Table 3.5.

24-hour recall assessments compared to the “Eatwell Guide” recommendations.

	Fruits & vegetables	Beans, pulses, fish, eggs, meat and other proteins	Potatoes, bread, rice, pasta and other starchy carbohydrates	Dairy & alternatives	Hydration
“Eatwell Guide”	≥5 portions a day 80g = 1 portion 150ml juice=1 portion ^a	≤70g/day of red and processed meat. ^a 40g/day of which 20g is oily fish. ^b	≥50% of food energy ^a	173g/day ^b	6-8 glasses per day ^a
Ebou	2.16 portions = 173g	205.2g	47.1%	20g	5 glasses
Matt	10 portions = 800g	346.8g	28.2%	0	12 glasses
Anna	6.03 portions = 482g	106g	43.6%	34.5g	8.4 glasses
Em	19.9 portions = 1591g	20g	67.3%	20g	3.16 glasses
Sarah	9.2 portions = 615g + 220ml juice	221.8g	50.6%	165g	3.96 glasses
Lynn	7.18 portions = 574g	66g	58.8%	20g	3.36 glasses
Silvia	6.76 portions = 485g + 46.2ml juice	159g	68.1%	0	1.6 glasses
Elizabeth	13.8 portions = 1032g + 120ml juice	216g	44.3%	0	5.2 glasses

Table 3.5. Continued.

24-hour recall assessments compared to the “Eatwell Guide” recommendations.

	Fruits & vegetables	Beans, pulses, fish, eggs, meat and other proteins	Potatoes, bread, rice, pasta and other starchy carbohydrates	Dairy & alternatives	Hydration
“Eatwell Guide”	≥5 portions a day 80g = 1 portion 150ml juice=1 portion ^a	≤70g/day of red and processed meat. ^a 40g/day of which 20g is oily fish. ^b	≥50% of food energy ^a	173g/day ^b	6-8 glasses per day ^a
Rafaela	1.38 portions = 110g	165g (processed meat)	45%	20g	8.8 glasses
Cat	1.25 portions = 100g	50g (processed meat)	52.2%	75g	1.6 glasses

Note: ^a“Eatwell Guide” recommendations (2016).

^b “Eatwell guide” recommendations according to Scarborough et al. (2016).

Discussion

The present study aimed to pilot the feasibility and utility of simultaneously exploring dietary practices and psychological traits and states of individuals with possible orthorexic tendencies. Of particular interest was whether individuals exhibiting ON would present a dietary pattern specific to this elusive condition.

Of note was the high level of disparity across participants' psychometric scores, 24-h recalls and self-reported dietary preferences. We chose three participants to demonstrate the extent of disparity identified within the study population. Em was chosen because of a score in the OCD range as identified by the OCI-R, Ebou was chosen because of a high score on the SoC scale and Rafaela was selected as a result of scoring in the eating pathology range on the EAT-26. All are referred to by their chosen pseudonyms.

Previous research suggests a possible link between ON and OCD (e.g. Koven & Senbonmatsu, 2013). In the present study, only one participant (Em) scored within both orthorexic and OCD ranges. Em is a 35-year-old female who identified her diet as vegan, which she said she follows to maximise her health & physical appearance as well as for ethical reasons. Obsessive preoccupation with food and strict adherence to food consumption rituals have been proposed as defining characteristics of ON in studies attempting to identify its diagnostic criteria (Barthels et al., 2015; Dunn & Bratman, 2016; Moroze et al., 2015). However, the role of obsessive-compulsive behaviours as defining features of ON is not yet established. Several studies suggest that people who display obsessive-compulsive features have a greater risk of ON, although these tendencies were not limited to

food-related behaviours (e.g. Bratman, S., Knight, 2000; Hayes et al., 2017).

Perhaps typical obsessive-compulsive behaviours (e.g. washing or contamination compulsions, excessive checking) are more likely to surface in relation to eating behaviours too. No studies, to our knowledge, suggest a link between veganism and OCD. Her intense interest in food (she describes herself as very particular about the foods she eats), therefore, appears to reflect Em's possible orthorexic tendencies which expresses through her veganism. Orthorexic tendencies may lead to adverse consequences for an individual, however, caution should be exercised when assigning a label of pathology to orthorexic tendencies (Strahler & Stark, 2020). The use of ORTO-15 in the present study limits our ability to interpret Em's possible orthorexic tendencies as pathological.

Ebou is a 32-year-old male who reported following a halal diet for religious reasons. He also reported consuming only organic fruits and vegetables and avoiding processed foods plus products containing additives or exposed to pesticides. Ebou scored within the orthorexic range on ORTO-15 and obtained the highest score possible on the SoC questionnaire indicating exceptionally high levels of personal control. Control has been highlighted as central in previous research on AN (Bruch, 2001). Individuals suffering from AN constantly strive for control over their dietary intakes, activity levels and body weights (Slade, 1982). Control over body weight may be used by those with AN as an index of their overall self-control and self-worth (Fairburn et al., 1999). Although accounts of the role of perceived self-control in eating disorders differ, the common underlying feature is that individuals control their eating behaviours as a coping strategy when there is a lack of perceived control

in other aspects of daily life (Fairburn et al., 1999). Ebou did not score within the OCD or eating disorder pathology ranges, although high scores on SoC scale are related to both. A recent review on ON (McComb & Mills, 2019) suggested that control over eating behaviour is important for individuals displaying ON symptoms and those suffering from AN, although the difference lies in their motivations. Although those with ON symptoms control their intake based on the perceived quality of foods, those diagnosed with AN control the quantity of foods consumed. There are also differences in the ideal body images of the two groups. Individuals with orthorexic tendencies seek ‘pure’ bodies (Steven Bratman, 2017) whereas the ideal body shape and weight for those with AN is significantly underweight (Dakanalis et al., 2016). Nonetheless there may be closer relationships between some aspects of ON and body weight than previously assumed. One recent distinction is that between ‘healthy’ orthorexia and ON (Barrada & Roncero, 2018). There is nothing intrinsically wrong with the desire to eat a healthier diet; indeed it is encouraged. Researchers, therefore, proposed that ON can be viewed as a two-dimensional construct; healthy/protective and pathological (Depa et al., 2019), with different motives for food choices between individuals who score in the ON range and those identified as having ‘healthy’ orthorexic tendencies (Depa et al., 2019). Weight control was the strongest motivator among the ON group whereas the healthiness of food motivated the healthy orthorexia group. In the present pilot study, participants did not identify weight loss as a motivator for their chosen dietary practices.

Only one participant had scores simultaneously indicative of possible ON and of pathological eating patterns using EAT-26. Rafaella is a 27-year-old female

who reported no religious or ethics-based dietary restrictions and only buys groceries using an organic food delivery service. Earlier studies linked pathological eating attitudes and ON (Segura-Garcia et al., 2015). Similarities between ON and established eating disorders, such as adapting one's lifestyle to suit eating patterns, over-concern about food, and constructing one's identity based on diet have been identified (Cena et al., 2019). The relationship between ON and recognised eating disorders is complex. ON may represent a mechanism for past sufferers of eating disorders to retain control over their food intake, with a different justification for dietary restrictions (Segura-Garcia et al., 2015). Individuals who have recovered from an eating disorder may follow special diets (e.g. vegetarianism or veganism) to continue restricting their food intakes in a socially acceptable way (Bardone-Cone et al., 2012). Similarly, orthorexic behaviour characterised by restricting intake to foods considered "healthy" or "pure" may be an excuse to control the amounts of food consumed that would otherwise worry health care professionals. An examination of the prevalence and progression of ON among patients suffering from AN and BN found that, although the eating disorder symptoms decreased after treatment, orthorexic tendencies increased (Segura-Garcia et al., 2015). It is possible that ON can be considered a residual symptom of eating disorders or a coping behaviour to overcome AN symptoms, where patients shift their focus from food quantity to quality (Barthels et al., 2017). Another possibility is that ON might result from cognitive-behavioural therapy that aims to change patients' perceptions of food as threatening to their body shape. Patients are encouraged to establish a pattern of regular eating (Murphy et al., 2010). From this perspective, ON offers a

compromise; at the same time as perceiving eating as a “body-protective” practice, patients can still maintain control over their eating patterns.

Dietary assessments.

As with the psychometric measures, participants’ dietary intakes varied. One of the defining features of ON is obsessive striving for a healthy diet (Dunn & Bratman, 2016). However few studies have examined the extent to which the ON diet could actually be considered healthy.

Em’s dietary intake was characterised by lower than recommended intakes of energy, protein, fat, iron, calcium, vitamin B₁₂ and zinc. Her carbohydrate, fibre, vitamin A and C intakes exceeded recommendations. Previous studies comparing diets of vegans with omnivores similarly identified lower energy, protein, fat and calcium intakes and higher fibre intakes (Clarys et al., 2014). Adherence to a vegan diet is not generally viewed as pathological. People who choose veganism cite various reasons, which include animal welfare, ecological reasons, culture, religion and health. On one hand, studies report lower blood cholesterol levels, rates of cardiovascular disease, hypertension, obesity and diabetes mellitus among vegans compared to their omnivore counterparts (Clarys et al., 2014). On the other, adherence to a vegan diet is associated with increased risk of anaemia (Waldmann et al., 2005) and osteoporosis (Lau et al., 1998). Furthermore, having any dietary restrictions, regardless of whether these are for ethical or weight reasons, was associated with more orthorexic behaviour compared to individuals with no restrictions (Barthels et al., 2018). More recent evidence suggests that ON is associated with differing motivation for following a vegan diet (Barthels et al.,

2020). Namely, health, aesthetics and healing were associated with orthorexic tendencies whereas animal welfare, politics and ecology were not.

There are some similarities between Em's and Ebou's nutrient intakes. Ebou's intake was characterised by lower than recommended energy, fat, iron, calcium, polyunsaturated fats, fibre, folate, vitamin A, and zinc, whereas intakes of protein, vitamin B₁₂ and vitamin C were higher. Both avoided dairy products albeit for different reasons (ethical versus physical symptoms post-consumption).

Rafaela's diet suggested a number of issues, with low intakes of energy, carbohydrates, fat, PUFA, fibre, iron, calcium, folate, vitamins C and A, and an intake of saturated fatty acids that exceeded recommendations. Her diet included a high intake of processed red meat (165 g/day compared with the recommendation of <70g/day) and an inadequate consumption of fruit and vegetables (1.38 portions). This indicates a discrepancy between a major feature of ON (striving for a healthy diet) and actual intake. A high intake of red and processed meat is a risk factor for bowel cancer and the consumption of little, if any, processed meat and a minimum of five portions of fruit and vegetables daily is recommended (World Cancer Research Fund, 2018). Indeed, despite the variations between individual diets, all participants' dietary intakes were characterised by inadequacies compared to recommendations (Table 3).

In this small sample of individuals with rigid and highly restrictive dietary intakes, there are a number of interesting observations. Eight of 10 participants displayed characteristics of ON using ORTO-15, whereas only one displayed features of disordered eating, using EAT-26. Most participants described usual

intakes that failed to meet healthy eating guidance, despite a strong motivation for, and commitment to, pure and healthy diets. The conceptualisation of ‘pure’ and ‘healthy’ clearly differs greatly among individuals because no single pattern of restrictions was identified. Bratman (S. Bratman, 1997) also found that definitions of “a healthy eating behaviour” differed among those with ON. All of our participants described rigid diets with a lack of variation day-to-day. If true, long-term dietary health is a concern. Although discipline in relation to diet and activity is needed to achieve and maintain a healthy weight and adequate dietary intake, the level of self-discipline described by participants in this pilot exceeded what might be considered usual or desirable.

The present pilot study aimed to identify the type and nature of eating practices of a group with orthorexic tendencies, comparing intakes with dietary recommendations. The results obtained suggest that there is no single dietary pattern characteristic of those with possible orthorexic tendencies, nor can the patterns of restrictions adopted be described as healthy. Intakes described failed to meet dietary recommendations for several nutrients. Failure to meet nutritional guidelines is not exclusive to this sample and according to the National Diet and Nutrition Survey (NDNS) rolling programme, many adults fail to meet the recommended daily amounts for several nutrients (England Public Health Agency, 2017). However, the individuals in the present study claimed to adhere to a healthy diet. Similarly, psychological test results were characterised by disparity between individuals, illustrating the difficulties inherent in diagnosing this condition. This suggests that no single psychometric measure is sufficient and that identification of ON should

include a range of diagnostic tools. The present study indicates that a positive diagnosis might include scoring within obsessive-compulsive eating pathology ranges and attaining a high score on a measure of perceived control.

The data for this research derive from a larger study aiming to explore all aspects of ON. Dietary intake and psychometric measures were recorded as part of in-depth qualitative interviews to obtain a holistic view of dietary restrictions, what they meant to individuals and aspects of their psychology. The findings suggest that this approach is useful in helping to identify potential diagnostic elements of ON, as well as participants' reasons for their dietary choices. Understanding the context of dietary choice is an essential component of dietetic treatment, enabling tailored approaches. Our intention is to follow up the participants to gain a more comprehensive view of the dietary patterns associated with possible ON.

Although this pilot study offers an interesting view of aspects of this elusive condition, a number of limitations were identified. Recruitment of participants to ON studies is challenging because there are no officially accepted diagnostic criteria for ON. The present study used the ORTO-15 questionnaire to assess ON symptoms. Despite being the most frequently used tool, it has been criticised for identifying cases of peculiar dieting as pathological and overestimating the prevalence of ON (Valente et al., 2019). In addition, its validity and reliability have been questioned (Roncero et al., 2017). It has been suggested that using a lower cut-off point of 35 would result in an improvement (Ramacciotti et al., 2011); however when we did so in the present study, the same eight individuals were identified as having possible orthorexic tendencies (Table 8).

Dietary intake was recorded using self-reported 24-h recalls, which are subject to misreporting (Burrows et al., 2019; Johansson et al., 2001). Misreporting of food intake has been associated with dietary restraint and is more likely in women (Macdiarmid & Blundell, 1998). Because ON is characterised by strict dietary restrictions, it is very likely that our participants under-reported their food intakes, so the macro and micronutrient deficiencies observed may be overestimated. Dietary consumption is complex with potentially large seasonal and day-to-day variations. Intakes over 24-h give a limited overview of dietary patterns, particularly of micronutrient intakes. The individuals in the present study indicated high dietary rigidity with little variation in the foods consumed. Given the nature of the condition a decision was made to explore dietary intakes in the pilot study using the least invasive methods, in addition to self-reported weights and heights. However, in the longer term follow up, we intend to explore diets in more detail with a more comprehensive dietary assessment method.

Of the other psychometric measures, OCD-I, SoC and EAT-26, similar to previous research (Hayes et al., 2017; Koven & Senbonmatsu, 2013; Segura-Garcia et al., 2015; Tremelling et al., 2017) identified that individuals with possible orthorexic tendencies also present eating behaviours indicative of pathology, high levels of perceived personal control and obsessive-compulsive tendencies. These measures will contribute to our understanding of ON in future work along with a reliable measure of ON. The MBSRQ and RSES scales did not identify issues with participants' self-esteem and body image, suggesting that motivations for adhering to a diet striving for "health" may not be related to concerns about physical appearance

and self-esteem. In future work, the use of the Teruel Orthorexia Scale (Barrada & Roncero, 2018) not only to identify individuals with orthorexic tendencies, but also to distinguish between healthy and pathological dimensions of ON would be useful. Comparison of the dietary intakes of individuals identified as ‘healthy ON’ with those with a pathological score would be insightful.

In conclusion this small pilot study demonstrates considerable heterogeneity between individuals scoring within or just over the cut-off points for identification of ON using the most frequently used diagnostic tool. No single pattern of dietary restrictions was identified that could flag up such individuals in practice; similarly, their psychometric measures demonstrated considerable variation. Of note that despite expressing a strong motivation for clean and healthy nutrition, the dietary intakes of participants did not represent a healthy diet. High levels of dietary restraint and excessive rigidity in terms of intake will always raise concerns. However, within the ON population those with weight concerns may be a group of greater concern to healthcare professionals.

Chapter 4. Development of the Screening Tool for Orthorexia Nervosa (STONE).

The aim of the studies outlined in this chapter was to develop a scale for assessment of ON. Due to limitations of the existing measures discussed in Chapters 1 and 2, the work presented in this chapter builds on the findings outlined in Chapter 3, which informed the series of studies presented in this chapter and were carried out to develop a new measure of ON independent of existing questionnaires.

Results from Chapter 2 showed that the existing measure of ON (ORTO-15) used in most publications has not being based on the most recent diagnostic criteria proposed by Dunn and Bratman in 2016 (Valente, Syurina, and Donini, 2019). In addition, thematic analysis of participants' comments revealed that the drive for healthy was motivated by the desire to enhance physical appearance and food was perceived as the “fuel” for the body. On the contrary to the proposed diagnostic criteria, social isolation as consequence of adherence to the diet of choice was not perceived as a negative consequence, which warrants further investigation into the impact of self-imposed dietary rules on individuals' social functioning. Items reflecting this dimension of ON should, therefore, be examined for their potential to define orthorexic symptoms.

Qualitative findings in Chapter 3 of this thesis outlined four themes that emerged from the interviews with individuals suspected to present behaviours reflective of the ON. One of the established contributors to disordered eating practices, such as AN, is the strive for control (Fairburn et al., 1999). Moreover, this concept was identified as one of the major themes in individuals accounts outlined in

Chapter 3 of this thesis. None of the existing questionnaires, however, attempt to measure this concept as a potentially salient feature of the ON. Another dimension that current questionnaires tend to omit is the relationship between ON and physical activity. Studies suggest that ON is most often seen in men with high level of physical activity (Malmborg et al., 2017), positively associated with exercise addiction (Rudolph, 2018), and is more prevalent in athletes compared to general population (Segura-García, 2013). Considering these findings preoccupation with physical activity could, therefore, be one of the identifying features of the ON.

Pilot study of dietary intakes of individuals with possible ON (Study2 in Chapter 3) highlighted that despite the deficiencies of several nutrients in participants' dietary intakes there was no one single pattern that could characterise orthorexic nutritional behaviour. When considering the findings of both, qualitative and nutritional, studies the common features among the individuals with possible ON were very particular beliefs about foods' harmful and health-enhancing properties, motivation to maintain or achieve physical appearance, and a desire for control over food preparation and consumption which impacted other aspects of individuals lives.

4.1 Aims. The work in this chapter aims to develop a new screening tool for ON. The findings of the previous studies in chapters 2 and 3 indicate that ON is a complex condition with great individual variations. The new screening tool should, therefore, be able to capture the complexity of ON. The tool should include appearance and physical activity as motivating factors, behavioural aspects (rigid control, preoccupation with the topic of nutrition, compensatory behaviours),

nutritional aspects (particular nutrients and foods considered “impure”), social functioning aspect, and the aspect measuring the extent of identification with one’s diet and its impact on self-worth.

4.2 Overview of the studies.

The scale development process comprised four distinct phases: Study 1 focused on generating the item pool and initial testing for psychometric properties. Study 2 examined the factor structure of the scale. Study 3 was conducted to establish evidence for validity and re-examine the factor structure of the scale with the independent sample. Finally, Study 4 was conducted to establish test-retest reliability of the developed measures. The process is depicted in Figure 4.1 below.

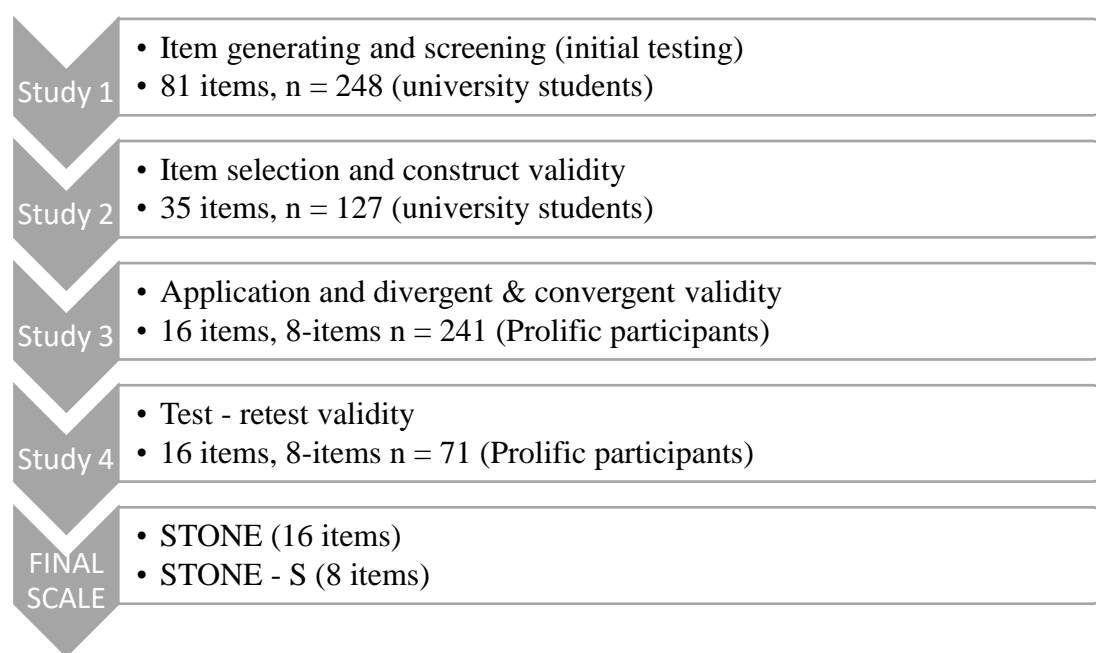


Figure 4.1. Stages of the scale development process.

4.3 Study 1.

Aim. The first study aimed to generate and test the items for the new measure of ON.

Participants. The initial sample consisted of 260 individuals. However, because some of the individuals did not respond to all items of the scale under development; the final sample consisted of 248 responses. The remaining participants were aged 18 to 68 years ($M = 26$, $SD = 9.66$). There were 130 individuals who identified as men and 119 individuals who identified as women. Most represented ethnic group was White English ($n = 60$, 24.1%) and any other White background ($n = 60$, 24.1%) followed by White British ($n = 13$, 5.2%), Black African ($n = 13$, 5.2%), Indian ($n = 12$, 4.8%), Pakistani ($n = 11$, 4.4%), Bangladeshi ($n = 11$, 4.4%), any other Asian background ($n = 10$, 4%), Chinese ($n = 8$, 3.2%), Arab ($n = 8$, 3.2%), Black Caribbean ($n = 7$, 2.8%), and Mixed White and Black and Mixed White and Asian (both $n = 6$, 2.4%). Most participants ($n = 168$, 67.5%) indicated UK as their country of residence. The majority indicated English language as at least one of the languages spoken at home ($n = 146$, 59.6%). No exclusion criteria were applied on the bases of the socio-demographic characteristics. The only exclusion criterion was that participants had to be at least 18 years old.

Recruitment. Recruitment took place in-person and online. Undergraduate students of Kingston University were approached and asked for a voluntary participation in this study. Students were then asked to complete a hard copy of the survey. Online participants were contacted via email and social media platforms (Facebook and Instagram) and asked to complete identical survey hosted on a closed

platform (SurveyMonkey). Participants were encouraged to share the link to the survey with their acquaintances.

Data collection. Participants were provided with the link to the survey or with the pen/paper form of the questionnaire. Information sheet, which outlined the aims of the study, conditions for withdrawal, treatment of the data, and emphasised anonymity and confidentiality was provided either as an embedded part of the questionnaire (online collection) or as the first page attached to the survey. Questionnaire with the information sheet can be found in Appendix 4. Completion of all measures took from 10 to 20 minutes.

Measures

Demographic measures. All participants were asked to report their age, gender, ethnicity, country of birth, country of residence, and language spoken at home. Information about participants' country of birth, country of residence and language spoken at home was asked to ensure that language would not be an issue when completing the survey.

Anthropometric measures. Participants were asked to report their height (in feet and inches or in metres and centimetres) and weight (in pounds or in kilograms). Individuals were asked to indicate their self-perceived weight status with possible responses "underweight", "normal weight", "overweight", and "obese". Participants were also asked to report if they have any dietary restrictions in their day-to-day diet, the type, and the duration of adherence to these restrictions.

Health and diet adherence related questions. The questions asked participants if they were ever diagnosed with an eating disorder, obsessive-compulsive disorder, and if they have any medical condition that impacts their eating behaviour. For the exact wording of these questions see Appendix 4.

Bratman Orthorexia Test. The test (Bratman, 2017) includes six statements with “true for me” and “not true for me” response options. According to Bratman (2017), agreement to at least one of these statements indicates that an individual may be developing ON.

Scale development. Based on the review of the literature and on the findings from the qualitative interviews the list of items was developed to reflect the main themes, the diagnostic criteria, and the ON correlates that were highlighted in the literature review (i.e. physical activity). The items were scored on a 6-point Likert type format with possible responses “strongly disagree”, “disagree”, “slightly disagree”, “slightly agree”, “agree”, “strongly agree”. The neutral response was not included as eliminating neutral response can reduce the social desirability bias in responses (e.g. Garland, 1991). The list consisted of 81 statements and can be found in the Table 4.1 below.

Table 4.1

Items of the scale.

Preoccupation	I spend a considerable amount of time preparing food. I frequently seek information about nutrition (e.g. on the internet, reading books on nutrition). My food choices are based on a desire to maximise my health.
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	<p>I think about healthy eating while doing something else.</p> <p>I spend a lot of time researching nutritional composition of foods.</p> <p>Nutrition is a hobby of mine.</p> <p>I actively seek the latest trends/information/news in nutrition.</p>
Compensatory behaviours	<p>If I eat something outside my diet, I will try to make up for it and eat less or exercise more the next day.</p> <p>I regularly perform a cleanse (e.g. detox, fast).</p> <p>I feel guilty if I miss a workout.</p> <p>I feel guilty when I eat unhealthy food.</p> <p>I feel bad if I can't complete my workout plan for the day.</p>
Rigidity/Control	<p>When I go on holiday, I always make sure I can stick to my eating habits.</p> <p>If I don't find foods I approve of I'd rather not eat at all.</p> <p>I make sure I eat at the same time of day.</p> <p>It's difficult to find a restaurant that serves the foods that I eat.</p> <p>I'm very specific about my food choices.</p> <p><u>I don't restrict myself when it comes to food.</u></p> <p>In the past year, my diet has become more complicated.</p> <p>I don't explore new foreign foods.</p> <p>Other people have mentioned that my diet is too restrictive.</p> <p>I am able to avoid straying off my diet even when I feel low.</p> <p>I plan my meals in advance.</p> <p>The availability of certain foods influences my choice of holiday destinations.</p> <p>I bring my own food with me wherever I go.</p> <p>I carefully monitor the nutritional composition of what I eat.</p> <p>I plan when to allow myself a treat outside of my diet.</p> <p>I measure every portion.</p> <p>I buy food products I know.</p> <p>My diet has many rules.</p> <p><u>I can have any food as long as I consume it in moderation.</u></p> <p>I don't trust anyone to do food shopping for me.</p> <p>I rarely allow myself a treat outside of my diet.</p> <p>It's important for me to know where the food I buy comes from.</p>

	<p>I follow a very strict diet (e.g. vegetarian, vegan, frugivore).</p> <p>I avoid food that I haven't prepared myself.</p> <p>It's important for me to know where the food I buy at the supermarket/market comes from.</p> <p>I don't trust the information provided on the food labels.</p>
Physical activity	<p>I feel bad if I can't complete my workout plan for the day.</p> <p>My food choices are based on my desire to maximise my fitness performance.</p> <p>The main function of food is to fuel my body.</p> <p>I have a strict exercise routine to complement my diet.</p>
Identity, self-worth.	<p>Healthy eating is a large part of who I am.</p> <p>I feel a sense of achievement when I stick to my diet.</p> <p>I am what I eat.</p> <p>Being able to stick to my diet has a positive impact on my mood.</p> <p>I feel better about myself when I manage to avoid slipping off my healthy diet.</p> <p>I make sure that my diet is better than most people's diet.</p>
Purity	<p>Only certain foods are healthy for me to eat.</p> <p>I try to eat only organic foods.</p> <p>I try to keep my body as pure as possible.</p> <p>My diet has more health benefits than other diets.</p> <p>I avoid foods that were treated with pesticides.</p> <p>I avoid processed foods.</p> <p>My body is pure because of my healthy diet.</p> <p>I avoid genetically modified foods.</p> <p>I carefully check the ingredients before I buy a food item.</p> <p>I eat only healthy food.</p> <p>Some foods have medicinal properties.</p>
Social	<p>I enjoy meeting people with similar eating habits to mine.</p> <p>My family has to make me a separate meal/dish when eating together (e.g. Christmas, Easter).</p> <p>I follow my diet because I want people to like me.</p> <p>My friend/family don't understand my eating habits.</p> <p><u>My eating habits do not dictate my social life.</u></p> <p>I don't enjoy the company of people with unhealthy eating habits.</p> <p>If I wasn't eating the way I do, people wouldn't be interested in me.</p>

	My friends and family have similar eating habits.
	I go out less frequently since I began eating healthy.
	I am happy to tell others about my eating habits.
	Most of my social interactions involve a discussion about my eating habits.
	I try to convince others to follow my healthy eating habits.
	I would rather miss a social event than my workout session.
	<u>I am accepting of other people's eating habits.</u>
Appearance	I don't eat certain foods because I believe they are bad for my skin.
	My diet is designed to keep me at a specific weight.
	I follow my diet in order not to gain weight.
	The main motivation behind my food choices is weight management.
	My chosen diet has a direct impact on my appearance.
	I eat healthy because I want to improve the way I look.

Note: Underlined items are reverse scored.

Statistical analyses. Statistical analyses were performed using IBM SPSS Statistics for Windows (Version 25.0). An EFA with varimax rotation was conducted to evaluate the distribution of scale's items into distinct factors. Intended decision making regarding the number of factors to retain was guided by the examination of eigenvalues with values greater than 1 indicating a significant factor in the structure of the items and on the Cattell's scree-test, which involves visual inspection of a plot of eigenvalues for breaks. Next step involved a cluster analysis in order to reduce the number of items. Cluster analysis is a technique used to identify groups of subjects without assuming linearity. This method has been widely used in health psychology research (Clatworthy et al., 2005). Then, each cluster was assessed by conducting an item-total correlation and identifying the items with the highest coefficients. Item-total correlation can be used to assess internal consistency of a scale (Rattray and

Jones, 2005). If the items are measuring the same underlying concept, they should each correlate with the total score of the subscale or questionnaire. Kline (2000) suggests retaining items with Corrected-Item-Total-Correlation values greater than .3. At this point item-total correlation was used to purify the scale from the less useful items and the acceptable value was set at $> .5$. EFA was conducted to explore the factor structure of the remaining items. Scree-plot and eigenvalues were examined again and items with large cross loadings were omitted from the scale.

Results

Sample characteristics. BMI of the sample ranged from 16.1 to 52.03 kg/m² ($M = 23.20$, $SD = 4.23$). Most participants reported not having any restrictions in their daily diets ($n = 145$, 58.5%). Of those that reported restrictions vegetarian and vegan diets were cited most often. Other restrictions included low carbohydrate, fat, sugar, dairy products, and “fast food”. Eighteen individuals (7.3%) reported an eating disorder diagnosis, while six participants (2.4%) reported having an OCD diagnosis. Most individuals did not report any medical or psychological conditions impacting their diet ($n = 210$, 84.7%). Adherence to religious diet was reported by 36 (14.5%) participants. Interestingly, the majority of participants in this sample answered affirmatively to at least five of the BOT items ($n = 153$, 61.7%) indicating a presence of ON tendencies among the sample.

Scale construction. Kaiser’s measure of sampling adequacy for the scale indicated the data were appropriate for exploratory factor analysis (EFA) (Kaiser, 1974). The value was .88. which Kaiser described as “meritorious”. This iteration of the EFA produced 20 factors with eigenvalues > 1.00 . Scree plot can be found below

in Figure 4.2 and Table 4.2 (Table 4.2 can be found in Appendix 5) presents items with the respective factor loadings.

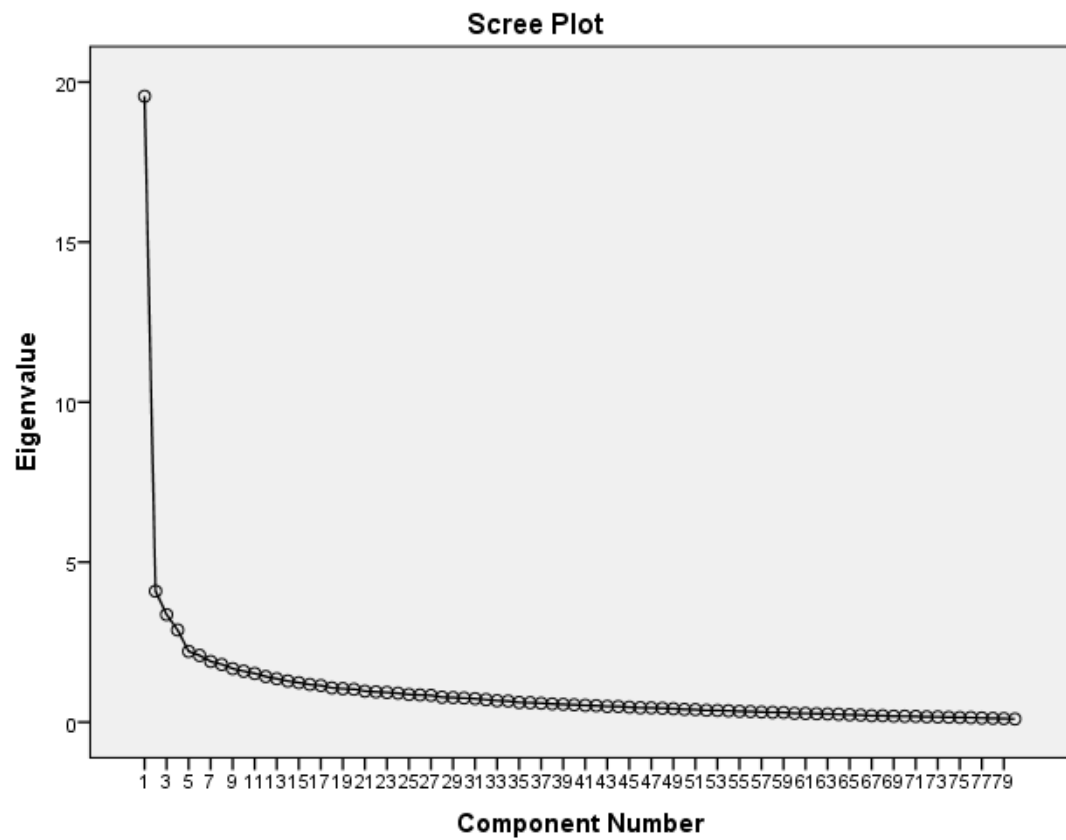


Figure 2.2. Scree plot representing 20 factors.

However, the analysis failed to reveal any meaningful factors consistent with the operationalisation of the ON. This could have resulted from the fact that ON is a complex condition where the theorised domains overlap with one another. For example, items that were developed to depict physical activity might have also tapped into behavioural preoccupation and social functioning domains. In this study, a hierarchical agglomerative cluster analysis identified 7 clusters. One cluster was omitted as it contained only one item. Table 4.3 presents the items with their respective cluster membership.

Table 4.3.

Items and Cluster Membership.

Items	Cluster membership
I spend a considerable amount of time preparing food	A
I frequently seek information about nutrition (e.g. on the internet, reading books on nutrition)	A
I have a strict exercise routine to complement my diet	A
Healthy eating is a large part of who I am	A
I carefully check the ingredients before I buy a food item	A
My food choices are based on a desire to maximise my health	A
I think about healthy eating while doing something else	A
I enjoy meeting people with similar eating habits to mine	A
I'm very specific about my food choices	A
I spend a lot of time researching nutritional composition of foods	A
I don't restrict myself when it comes to food	A
My food choices are based on my desire to maximise my fitness performance	A
I plan my meals in advance	A
My diet has more health benefits than other diets	A
I am able to avoid straying off my diet even when I feel low	A

I feel guilty if I miss a workout	A
Nutrition is a hobby of mine	A
I feel bad if I can't complete my workout plan for the day	A
I actively seek the latest trends/information/news in nutrition	A
I carefully monitor the nutritional composition of what I eat	A
Only certain foods are healthy for me to eat	A
When I go on holiday I always make sure I can stick to my eating habits	B
I try to convince others to follow my healthy eating habits	B
I eat only healthy food	B
My body is pure because of my healthy diet	B
I bring my own food with me wherever I go	B
I try to keep my body as pure as possible	B
I try to eat only organic food	B
I plan when to allow myself a treat outside of my diet	B
I make sure that my diet is better than most people's diet	B
I try to convince others to follow my healthy eating habits	B
I don't eat certain foods because I believe they are bad for my skin	B
If I don't find foods I approve of I'd rather not eat at all	C
It's difficult to find a restaurant that serves the foods that I eat	C
My family has to make me a separate meal/dish when eating together (e.g. Christmas, Easter)	C
I follow my diet because I want people to like me	C
My friends/family don't understand my eating habits	C
I regularly perform a cleanse (e.g. detox, fast)	C
My eating habits do not dictate my social life	C
I don't explore new/foreign foods	C
I don't enjoy the company of people with unhealthy eating habits	C
Other people have mentioned that my diet is too restrictive	C
If I wasn't eating the way I do, people wouldn't be interested in me	C
The availability of certain foods influences my choice of holiday destinations	C
I don't trust the information provided on the food labels	C
I avoid food that I haven't prepared myself	C

I go out less frequently since I began eating healthy	C
I measure every portion	C
I follow a very strict diet (e.g. vegetarian, vegan, frugivore)	C
Most of my social interactions involve a discussion about my eating habits	C
I would rather miss a social event than my workout session	C
My diet has many rules	C
I don't trust anyone to do food shopping for me	C
I rarely allow myself a treat outside of my diet	C
I'm accepting of other people's eating habits	C
I feel a sense of achievement when I stick to my diet	D
I am what I eat	D
The main function of food is to fuel my body	D
Some foods have medicinal properties	D
I feel guilty when I eat unhealthy food	D
I eat healthy because I want to improve the way I look	D
My chosen diet has a direct impact on my appearance	D
I am happy to tell others about my eating habits	D
Being able to stick to my diet has a positive impact on my mood	D
I buy food products I know	D
I feel better about myself when I manage to avoid slipping off my healthy diet	D
I make sure that I eat at the same time of day	E
I avoid genetically modified foods	E
I avoid processed foods	E
I avoid foods that were treated with pesticides	E
If I 'm not sure about the quality of food, I will not eat it	E
It's important for me to know where the food I buy at the supermarket/market comes from	E
My friends and family have similar eating habits	E
I only buy brands I trust	E
It's important for me to know where the food I buy comes from	E
If I eat something outside of my diet, I will try to make up for it and eat less or exercise more the next day	F

In the past year, my diet has become more complicated	F
The main motivation behind my food choices is weight management	F
I follow my diet in order not to gain weight	F
My diet is designed to keep me at a specific weight	F
I can have any food as long as I consume it in moderation	G

Examination of the item-total-correlation values resulted in retaining 41 items in the scale. Table 4.4 presents items retained for further analysis from each cluster and their Corrected-Item-Total-Correlation values.

Table 4.4.

Retained Items with their Corrected-Item-Total-Correlation coefficients.

Cluster	Items	Corrected Item-Total Correlation
A	Healthy eating is a large part of who I am.	.747
A	My food choices are based on a desire to maximise my health.	.737
A	Nutrition is a hobby of mine.	.690
A	I carefully monitor the nutritional composition of what I eat.	.669
A	I carefully check the ingredients before I buy a food item.	.662
A	I frequently seek information about nutrition (e.g. on the internet, reading books on nutrition).	.651
A	My food choices are based on my desire to maximise my fitness performance.	.650
A	I'm very specific about my food choices.	.649
A	I spend a lot of time researching nutritional composition of foods.	.648
A	I plan my meals in advance.	.617
A	My diet has more health benefits than other diets.	.617
A	I have a strict exercise routine to complement my diet.	.613
A	I actively seek the latest trends/information/news in nutrition.	.550
A	I think about healthy eating while doing something else.	.531
B	My body is pure because of my healthy diet.	.644

B	I try to keep my body as pure as possible.	.634
B	I eat only healthy food.	.587
B	I plan when to allow myself a treat outside of my diet.	.564
B	I make sure that my diet is better than most people's diet.	.504
C	My diet has many rules.	.658
C	It's difficult to find a restaurant that serves the foods that I eat.	.556
C	Other people have mentioned that my diet is too restrictive.	.539
C	I avoid food that I haven't prepared myself.	.539
C	My family has to make me a separate meal/dish when eating together (e.g. Christmas, Easter).	.536
C	I measure every portion.	.529
C	If I wasn't eating the way I do, people wouldn't be interested in me.	.523
C	I go out less frequently since I began eating healthy.	.520
C	Most of my social interactions involve a discussion about my eating habits.	.515
D	I feel a sense of achievement when I stick to my diet.	.720
D	Being able to stick to my diet has a positive impact on my mood.	.662
D	I feel better about myself when I manage to avoid slipping off my healthy diet.	.627
D	My chosen diet has a direct impact on my appearance.	.606
D	I eat healthy because I want to improve the way I look.	.565
E	It's important for me to know where the food I buy at the supermarket/market comes from.	.629
E	I avoid foods that were treated with pesticides.	.586
E	I avoid processed foods.	.509
E	I avoid genetically modified foods.	.506
F	I follow my diet in order not to gain weight.	.687
F	My diet is designed to keep me at a specific weight.	
F	The main motivation behind my food choices is weight management.	.574
F	If I eat something outside of my diet, I will try to make up for it and eat less or exercise more the next day.	.551

Next step involved running an EFA on the 41-item scale. Decision regarding the number of factors to retain was based on examining Cattell's (1966) scree-test, eigenvalues (> 1). Figure 4.3 presents the scree plot.

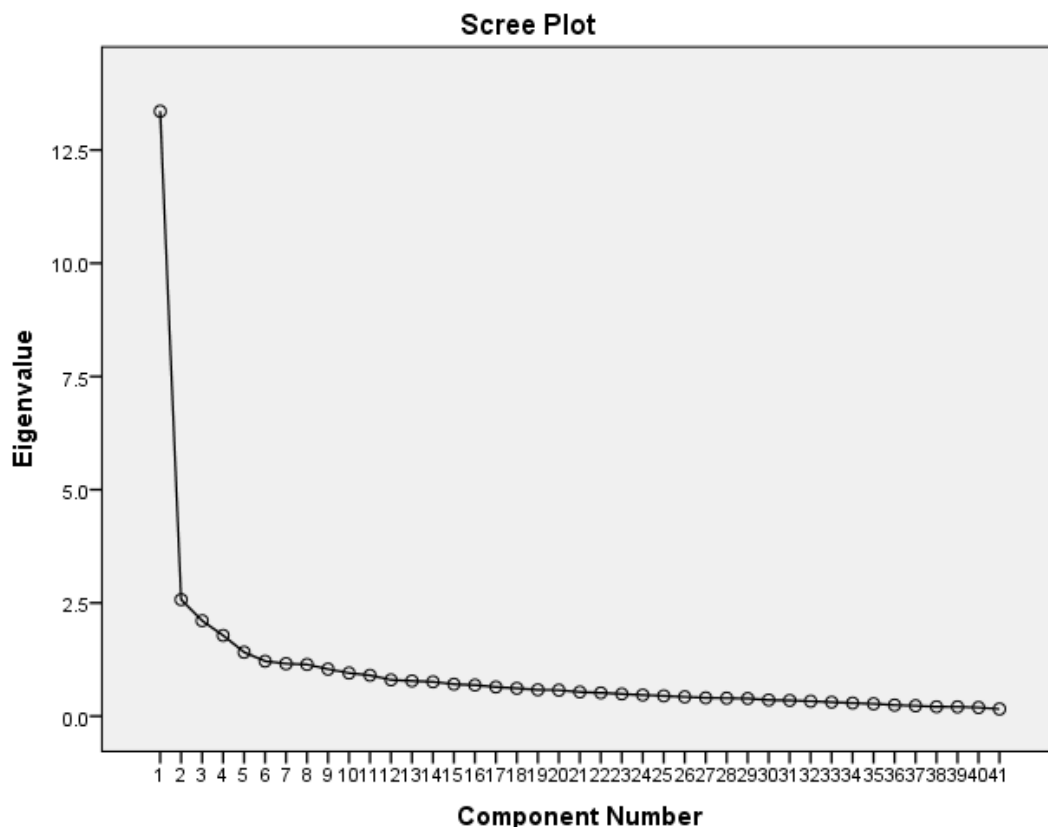


Figure 4.3. Scree plot representing 9 factors.

This iteration of EFA with varimax rotation produced 9 factors. However, two factors were removed as only two items loaded on factor 8 and one item on factor 9. Furthermore, items that had large cross loadings and items with loadings $< .4$ were removed. At this point, the combinations of the items necessitated a review of descriptive labels of the factors.

The first factor contained items reflecting several underlying characteristics of ON. For example, “I have a strict exercise routine to complement my diet” reflects the importance of physical activity in possible ON tendencies, while “Healthy eating is a large part of who I am” represents individual’s perception of a healthy diet as part of one’s identity. This component was, therefore, labelled “Health” as this seemingly wide definition was the common denominator of the five items. Items in

the second factor also reflected two underlying concepts representative of ON tendencies. “My chosen diet has a direct impact on my appearance” and “I eat healthy because I want to improve the way I look” referred to appearance as a motivating force behind adherence to a “healthy diet”. Remaining three items (e.g. “Being able to stick to my diet has a positive impact on my mood”) reflected positive affect as a result of avoiding to stray off the diet. This factor was labelled “emotional outcomes”. The third factor was named “restrictive diet”. All items reflected restrictive property related to dietary intake (e.g. “My diet has many rules”, “Other people have mentioned that my diet is too restrictive”). The fourth factor was labelled “appearance”; it included three statements outlining weight management as a motivation behind the diet of choice (e.g. “My diet is designed to keep me at a specific weight”). Items in the fifth component reflected a desire for a “pure” diet (e.g. “I avoid genetically modified foods”) and were gathered under the “Pure” label. The sixth factor’s items referred to preoccupation with nutrition (e.g. “I actively seek the latest trends/information/news in nutrition” and was named “Subject interest (nutrition)”. The final factor was labelled “control”; all items indicated rigid control around food consumption (e.g. “I measure every portion”). Table 4.5 presents retained items with their respective factor loadings and Cronbach’s alpha coefficients for each component. According to interpretations of alpha coefficients suggested by George and Mallory (2003) the values fall from acceptable ($> .7$) to good ($> .8$). Cronbach’s alpha for the scale was .938, which is considered excellent.

Table 4.5

Factor structure and Cronbach's alpha coefficients of the seven factors.

Items	F1	F2	F3	F4	F5	F6	F7
My diet has more health benefits than other diets.	.694						
Healthy eating is a large part of who I am.	.685						
I eat only healthy food.	.647						
My body is pure because of my healthy diet.	.561						
I have a strict exercise routine to complement my diet.	.521						
I feel a sense of achievement when I stick to my diet		.722					
Being able to stick to my diet has a positive impact on my mood		.638					
I eat healthy because I want to improve the way I look		.625					
I feel better about myself when I manage to avoid slipping off my healthy diet		.621					
My chosen diet has a direct impact on my appearance		.595					
It's difficult to find a restaurant that serves the foods that I eat			.690				
My family has to make me a separate meal/dish when eating together (e.g. Christmas, Easter)			.687				
Other people have mentioned that my diet is too restrictive			.672				
My diet has many rules			.594				
I avoid food that I haven't prepared myself			.484				
I'm very specific about my food choices			.480				
I go out less frequently since I began eating healthy			.387				
I follow my diet in order not to gain weight				.796			
My diet is designed to keep me at a specific weight				.700			

Table 4.5. Continued.

Factor structure and Cronbach's alpha coefficients of the seven factors.

Items	F1	F2	F3	F4	F5	F6	F7
The main motivation behind my food choices is weight management				.644			
If I eat something outside of my diet, I will try to make up for it and eat less or exercise more the next day				.614			
I avoid foods that were treated with pesticides					.798		
I avoid genetically modified foods					.773		
I avoid processed foods					.659		
It's important for me to know where the food I buy at the supermarket/market comes from					.604		
Most of my social interactions involve a discussion about my eating habits						.682	
Nutrition is a hobby of mine						.589	
I make sure that my diet is better than most people's diet						.540	
I actively seek the latest trends/information/news in nutrition						.486	
I spend a lot of time researching nutritional composition of foods						.448	
I plan when to allow myself a treat outside of my diet							.551
I measure every portion							.492
I carefully monitor the nutritional composition of what I eat							.481
Reliability (Cronbach's alpha)	.821	.844	.811	.805	.783	.791	.732

Note: F1 = Health; F2 = Emotional outcome; F3 = Restrictive diet; F4 =

Appearance; F5 = Pure; F6 = Subject interest (nutrition); F7 = Control.

Despite the satisfactory values of internal consistency demonstrated by the factors and the scale, some factors still lacked qualitative purity (i.e. some factors

contained items reflecting several theoretical dimensions), which warranted further investigation.

4.4 Study 2.

Due to issues with theoretical interpretability of the factors, the purpose of the second study was to re-examine the structure of the scale with the independent sample.

Participants. Initial sample for this study was 134 individuals. Seven participants provided only demographic information and did not complete any other measures. Their data was removed from the analysis, which resulted in a sample size of 127 participants (91 females, 36 males) and were aged from 18 to 68 years ($M = 31.05$, $SD = 11.06$). “Any other ethnic group” was the most represented category in this sample ($n = 40$, 31.5%) followed by White English ($n = 29$, 22.8%), Black British ($n = 14$, 11%), Asian Indian ($n = 8$, 6.3%), and Asian Pakistani ($n = 6$, 4.7%). UK was indicated as the country of residence for most participants ($n = 99$, 78%). Participants had to be at least 18 years old to participate in this study.

Recruitment. Participants were recruited via opportunity and snowball sampling techniques. Undergraduate students at the University Centre Croydon were asked to fill in a paper/pencil version of the questionnaire. Furthermore, a link to the survey hosted on a closed-circuit platform SurveyMonkey was mailed to Postgraduate students, which were members of the Science Engineering and Computing Faculty Student Society at Kingston University. Participants were encouraged to share the link to the survey with their acquaintances. Further recruitment was carried out via SurveyCircle platform. SurveyCircle is an internet platform which allows students to support each other by participating in each other's research projects. Data collection followed identical steps to the Study 1 of this

chapter. Information sheet was embedded in the survey or presented as a first page of the paper/pencil version. Completion of all steps took approximately ten minutes.

The full survey can be found in Appendix 6.

Measures

All questions, except for the scale under development, were identical to the questionnaire used in the previous study (Study 1 of Chapter 4).

Scale under development. The scale contained 35 items, 33 were identified in the previous study. Two additional items were added to the scale. One item was added to “control” subscale “All my meals are planned” and one to “appearance” subscale “My diet is good for my skin”. Both components were highlighted as reasons for adherence to the diet of choice in the qualitative study (Chapter 3) and were important contributors to the conceptualisation of ON when developing the items for the Study 1 (Chapter 4). Items’ order was randomised using the random number generator (www.random.org). Identical to Study 1 of this chapter a 6-point Likert type format with possible responses “strongly disagree”, “disagree”, “slightly disagree”, “slightly agree”, “agree”, “strongly agree” were used in this study.

Statistical analyses. EFA with oblimin rotation was conducted to explore the internal structure of the scale. Oblique rotation allows for correlations between the factors, suggesting a more complex and at the same time more realistic solution (DeVellis, 2012). To determine the number of dimensions to retain, parallel analysis (PA) was used (Horn, 1965) and was conducted using R software (R Core Team, 2017). In addition, visual inspection of the scree plot, factor loadings, eigenvalues, and face validity of the items were taken into consideration.

The factor structure of the 3-factor scale was evaluated using SPSS AMOS software (Version 23.0) (Arbuckle, 2014) through confirmatory factor analysis (CFA). The purpose behind examining CFA is to validate the identified factor structure and determine if factors and items relate as predicted by the existing theory. Absolute and relative fit indices were generated and examined. Hooper and colleagues (2008) advocate reporting the following indices: Chi-squared (χ^2) its degrees of freedom and p value, root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR), the comparative fit index (CFI) and one parsimony fit index such as parsimonious normed fit index (PNFI). Obtained values were compared with the acceptable thresholds of fit by indices recommended by Hooper et al. (2008), which were: χ^2 with a non-significant p value ($p > .05$), RMSEA value smaller than .07, SRMR value smaller than .08, CFI value greater or equal to .95, PNFI within the .50 region while other fit indices achieve values over .90.

Results

Sample characteristics. BMI of the sample ranged from 15.79 to 42.72 kg/m² ($M = 24.21$, $SD = 4.97$). Most individuals did not have any restrictions in their daily diets ($n = 82$, 64.6%). Those who reported restrictions in their diet avoided sugar, dairy, carbohydrates, “junk food”, and restricted their calorie intakes. Two individuals were following a vegetarian diet, two individuals were vegan, and two participants excluded gluten. Seven individuals reported an eating disorder diagnosis, two participants were diagnosed with anorexia nervosa, five participants had a diagnosis of bulimia nervosa in the past. Five participants reported an OCD diagnosis. Psychological and medical conditions influencing dietary choices were reported by nineteen participants. Most common conditions included depression and

anxiety. Twelve people were following a religious diet (halal and kosher). Six individuals (4.7%) answered affirmatively to at least five BOT statements.

Internal structure of the scale. The value of Kaiser's measure of sampling adequacy for the scale (.86) indicated the data were appropriate for EFA (Kaiser, 1974).

The results from the PA, which can be seen in Figure 4.4, suggested to retain three factors. Three eigenvalues from the sample were greater than the ones from the randomly generated datasets. Therefore, three factors were retained in the EFA.

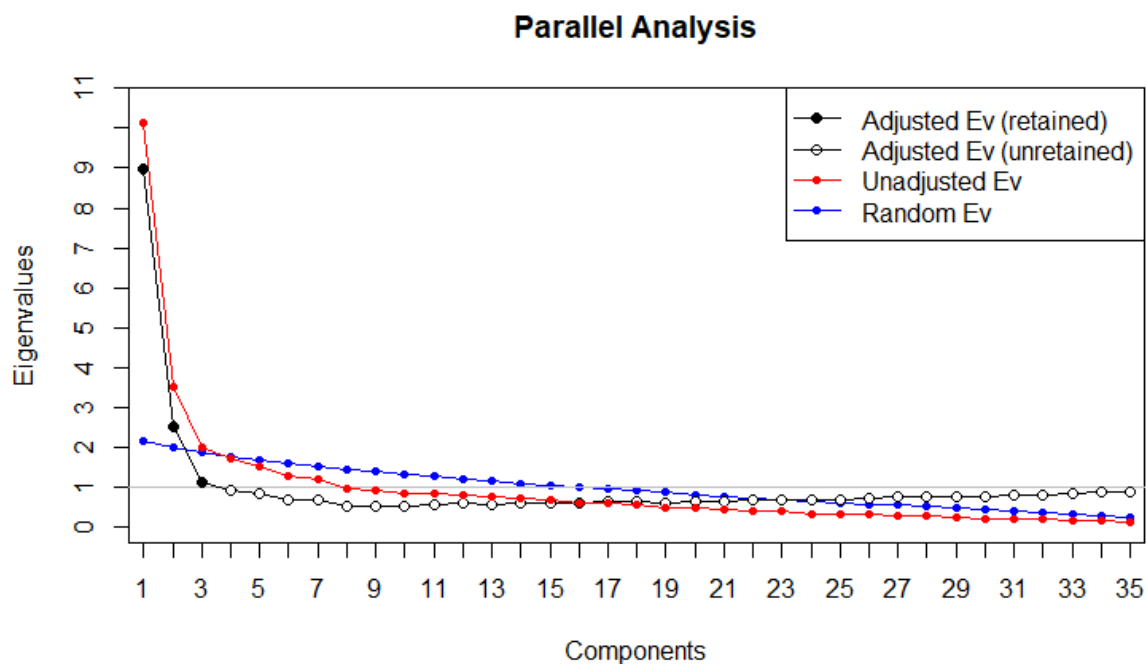


Figure 4.4. Parallel analysis of the Scale (35 items).

Factor loadings were examined in order to determine which items to retain. High factor loadings are desirable, but factor loadings above .30 indicate that item fits with a particular factor (Kline, 2000). Items with factor loadings lower than .30 were therefore removed. Three factors represented dimensions of “appearance” (7 items), “purity” (8 items), and “control” (6 items). Next, several items were removed

as they failed to demonstrate conceptual fit with the factors when face validity was considered. For example, two items were dropped from the “appearance” component. These items “I feel better about myself when I manage to avoid slipping off my diet” and “I feel a sense of achievement when I stick to my diet” describe the affective element of adhering to a diet rather than enhancement of one’s physical appearance. One item (“It’s difficult to find a restaurant that serves the foods that I eat”) was removed from the “control” component for the same reason. On face validity, this item describes the impact of restrictive diet on individual’s social functioning. Table 4.6 presents retained items and their factor loadings.

Table 5

Factor structure of the 16-item scale.

	Items	Appearance	Purity	Control
1	I follow my diet in order not to gain weight. (A1)	.815		
2	I eat healthy because I want to improve the way I look. (A2)	.812		
3	The main motivation behind my food choices is weight management. (A3)	.778		
4	My chosen diet has a positive impact on my appearance. (A4)	.675		
5	My diet is designed to keep me at a specific weight. (A5)	.646		
6	I avoid processed foods. (P1)		.777	
7	It’s important for me to know where the food I buy at the supermarket/market comes from. (C5)		.740	
8	I avoid genetically modified foods. (P2)		.718	
9	I eat only healthy food. (P3)		.698	
10	My diet has more health benefits than other diets. (P4)		.685	
11	I avoid foods that were treated with pesticides. (P5)		.657	
12	My diet is good for my skin. (A6)		.555	

Table 6. Continued.*Factor structure of the 16-item scale.*

	Items	Appearance	Purity	Control
13	Other people have mentioned that my diet is too restrictive. (C1)			.709
14	I avoid food that I haven't prepared myself. (C2)			.364
15	I measure every portion. (C3)			.343
16	I spend a lot of time researching nutritional composition of foods. (C4)			.331

Reliability statistics assessed by Chronbach's alpha coefficients were .84 for the "appearance", .82 for the "purity", .61 for the "control" subscales, and .84 for the whole scale. Factors in this iteration of EFA still contained items that lacked face validity. Item 12 in the table above, which loaded on "purity" component, rather reflects motivation for dietary choices to enhance one's appearance and is more appropriately suited for the "appearance" subscale. Item 7 ("It's important for me to know where the food I buy at the supermarket/market comes from") is another questionable item loading on "purity" dimension. The meaning of this item suggests restrictive practices when it comes to selecting foods, which better fits in the "control" dimension.

Confirmatory factor analysis. After assessing items for face validity, item 12 was included in the "appearance" component and item 7 was assigned to the "control".

Results for the 3-factor solution are presented in Figure 4.5. The goodness of fit statistics revealed that the model demonstrated a poor fit to the data,

$$\chi^2(223.02/101) = 2.208, p < .00; \text{RMSEA } .098; \text{SRMR } .113; \text{CFI } .817; \text{PNFI } .603.$$

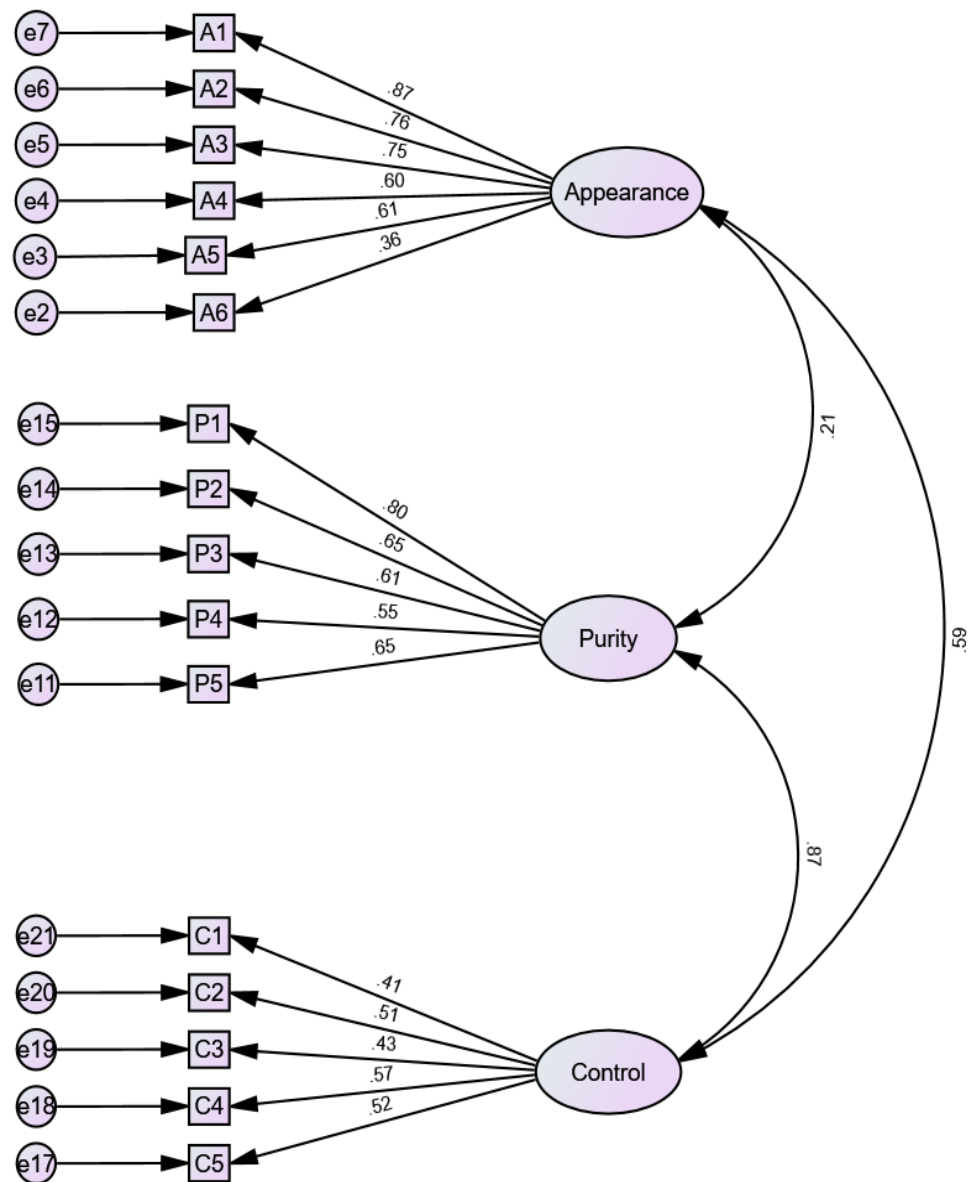


Figure 4.5. CFA 3-Factor Structure Goodness-of-Fit Model.

Modification indices (MI) were examined to identify the source of possible model misspecification. Evidence of misspecification was associated with pairings of error terms of items P3 and C2 (err13↔err20; MI = 13.136); A4 and C5 (err4↔err17); MI = 9.809; and C3 and C1 (err19↔err21; MI = 9.519). One way to

improve model fit is to allow for the error terms to correlate if the items associated with the high MI load on the same factor (Byrne, 2010). In this case, however, the highest MI values were observed between the error terms of the items from distinct factors. Although improved model is desirable, improving the fit would involve deleting the items with high MI values from the scale, which at this point of scale development would be premature. Furthermore, CFA was conducted with the same sample as EFA and the sample size was small, which might have influenced the model fit. Further adjustments are necessary, and scale's internal structure must be reassessed with a new sample.

4.5 Study 3.

Aims. The purpose of this study was to (1) confirm the factor structure for the scale in an independent sample, (2) to assess convergent and discriminant validity, (3) and to identify cut-off points for each subscale.

Rationale. The predictions are: (1) Appearance subscale would correlate with measures of eating pathology and with a measure of appearance orientation as the items reflect both a desire to control one's weight (e.g. "I follow my diet in order not to gain weight") and a desire to improve one's physical appearance (e.g. "My diet is good for my skin"); (2) Purity subscale would correlate with the measure of eating pathology as the items in this subscale reflect restrictive dietary practices aimed at consuming only foods considered "healthy" or "clean" (e.g. "I avoid processed foods", "I eat only healthy foods"); (3) Control subscale would correlate with the measure of obsessive tendencies, items reflect behavioural rigidity around food (e.g. "I measure every portion", "It is important for me to know where the food I buy at the supermarket/market comes from"). In addition, group of individuals that

scored at least 5 points (out of 6) on BOT scale will exhibit significantly higher scores than other groups on all subscales.

In line with the previous literature attempting to define diagnostic properties of ON (Dunn & Bratman, 2016) “Purity” subscale reflects individuals’ preoccupation with “clean” eating. Items describe categories of foods that individuals with possible ON avoid in their daily diets which emerged from the qualitative interviews (Chapter 3). Items in the “Appearance” subscale describe Individual’s motivation for following the diet of choice, which stems from the desire to enhance one’s physical appearance. Dunn and Bratman (2016) described weight loss as a secondary outcome of following the diet of choice. The interviews, however, revealed that losing or maintaining one’s weight was one of the primary motivations for seeking to eat “healthy”. This research, therefore, proposes this motivation as one of the primary defining features of the ON. The third subscale (Control) describes individual’s preoccupation with the topic of nutrition and rigid behaviours of food preparation and consumption. This dimension was included in the proposed diagnostic criterion A (“Compulsive behaviour and/or mental preoccupation regarding affirmative and restrictive dietary practices believed by the individual to promote optimum health.”). Based on the diagnostic criteria and on the results of the qualitative study the assumption of this research is that individual with possible ON would obtain high scores on all three dimensions. Cut-off scores, therefore, will be established for individual subscales. For the short version of the scale the cut-off point will be established considering the composite score of all eight items.

Participants. The sample included 241 individuals. All participants were at least 18 years old. BMI of the sample ranged from 14.7 to 51.8 ($M = 25.44$, $SD = 6.11$). Table 4.7 presents participants' groups and demographic information.

Table 4.7

Groups and demographic characteristics of participants.

Characteristics	n	%
Group		
BOT	44	18.3
Medical	42	17.4
Religious diet	29	12
ED	41	17
Prof. reasons	45	18.7
Control	40	16.6
Ethnicity		
White English/Welsh/Scottish/Northern Irish/British	190	79
Indian	13	5.4
Pakistani	11	4.6
Black African/British	9	3.8
White and Asian	4	2.1
White and Black African/Caribbean	3	1.2
Bangladeshi	3	1.2
White and Black African	1	0.4
Arab	1	0.4
Other	6	2.5
Marital status		
Never having been married or in civil partnership	140	58.1
Married/civil partnership	91	37.8
Divorced/civil partnership dissolved	8	3.3
Separated from spouse or partner	2	0.8
Children under 16 years old in household.		
No children	147	61
One child	46	19.1
Two children	29	12
Three children	16	6.6
Four children	2	0.8
Five children	1	0.4

Note: BOT - individuals that scored at least 5 points on BOT scale; Medical -

individuals that reported to have a medical condition (e.g. diabetes, irritable bowel syndrome) that impacts on their daily diet; Religious diet - those following a

religious diet (e.g. kosher, halal, Eastern Orthodox); ED - individuals self-identifying as having been diagnosed with an eating disorder; Prof. reasons - individuals that follow a specific diet to maintain their weight for professional reasons (athletes, models); Control - a group of healthy adults that do not self-identify with any of the above criteria.

Recruitment. The study used purposive sampling technique. Recruitment took place using Prolific.co. Prolific is an online platform for recruitment of participants with the aim to explicitly cater to researchers. Published academic article on the functionality and usability of this platform found it superior to *Amazon's Mechanical Turk* (Palan & Schitter, 2018). Participants were contacted via Prolific using their IDs on the web site. Prolific allows researchers to not only post a “call” for participation in a study but also to limit the visibility of this “call” to particular individuals. Once the “call” is visible, it is entirely up to Prolific participants to take (or not) part in the study. Participants were selected based on an existing large dataset collected for previous (unrelated) research projects. Participants' Prolific IDs were known to the research team from the Prolific data base of the first supervisor. Participant received a monetary reward for their participation (average reward per hour = 10.55£).

Measures

Participants provided demographic information, self-reported height and weight, the 16-item scale developed in previous study, and various self-report measures to assess the validity of the scale (described below).

Scale under development. The scale contained 16 items identified in Study 2 of this chapter and was hosted on SurveyMonkey. Items were presented in random

order to each participant. Response options remained the same as in the previous study.

The Eating Attitude Test (EAT-26; Garner et al., 1982). This questionnaire identifies pathological eating behaviours and attitudes. The test is not a diagnostic measure for eating disorders. Authors of the scale suggest that scoring above the cutoff point indicates a presence of a possible eating pathology but do not claim the scale's ability to establish an exact diagnosis. Responses are scored on a 6-point Likert-type scale ranging from "Never" to "Always". A total score was used for analysis with a total score of 20 and higher indicating a tendency towards disordered eating. One statement ("Enjoy trying new rich foods") is reverse scored. Internal consistency of this scale in this sample was .89.

The Obsessive-Compulsive Inventory Revised (OCI-R; Foa et al., 2002). The questionnaire is used to assess symptoms of obsessive-compulsive disorder. This scale is an 18-item measure scored on a 5-point Likert scale with a score of 21 and higher suggesting the presence of obsessive-compulsive tendencies. In this sample internal consistency was .92.

Multidimensional Body-Self Relations Questionnaire Appearance Orientation subscale (MBSRQ-AO; Cash, 2015). In this study only the AO subscale of the MBSRQ was used. The items of this subscale measure the extent of preoccupation and investment into one's physical appearance and grooming behaviours. There are 12 items with responses ranging from "Definitely Disagree = 1" to "Definitely Agree = 5". Scores are calculated by estimating an average. There is no cut-off score but author-provided population average for males is 3.60 and 3.91

for females. Higher scores indicate greater investment into one's appearance. In this sample internal consistency was .90.

Statistical analyses

CFA was conducted to examine the goodness-of-fit of 3-factor model identified in the previous study with the independent sample. The same measures as in the previous attempt to fit the model in study 2 of this chapter were used here. Namely, chi-squared (χ^2) its degrees of freedom and p value, RMSEA, SRMR, CFI and PNFI. Obtained values were compared with the acceptable thresholds of fit by indices recommended by Hooper et al. (2008), which were: χ^2 with a non-significant p value ($p > .05$), RMSEA value smaller than .07, SRMR value smaller than .08, CFI value greater or equal to .95, PNFI within the .50 region while other fit indices achieve values over .90.

A sum of scores for the items in each subscale (Appearance, Purity, Control) represented their respective scores. Other psychometric measures were scored in accordance with the authors' guidelines and bivariate correlations were calculated between "Appearance" and EAT-26, "Appearance" and MBSRQ-AO, "Purity" and EAT-26, Control and OCI-R. Internal consistency of the three subscales was reflected by Cronbach's alpha coefficients.

A one-way analysis of variance (ANOVA) was used to compare the scores of the six groups on the three subscales and on the composite measure. Post-hoc tests were carried out to identify between groups difference.

Receiver operator characteristic (ROC) signal detection analysis was carried out on scores of individual subscales (Appearance, Purity, and Control) to establish

the cut-off points. ROC analysis was also used to establish the cut-off score for the full (16 items) and short (8 items) versions of the scale.

Results

Kaiser's measure of sampling adequacy for the scale (.89) indicated the data were appropriate for analysis (Kaiser, 1974). Initial fit indices were poor, $\chi^2(555.84/101) = 5.503, p < .00$; RMSEA .137 SRMR .125; CFI .744; PNFI .595. Modification indices were examined and error terms with values >20 on the same factor were allowed to correlate. Misspecification was associated with pairings of error terms of items A4 and A6 (err4 \leftrightarrow err6; MI = 45.437); P2 and P5 (err8 \leftrightarrow err11 MI = 36.563); A3 and A4 (err3 \leftrightarrow err4; MI = 30.752); A3 and A6 (err3 \leftrightarrow err6; MI = 30.056); P1 and C2 (err7 \leftrightarrow err13; MI = 29.797); A1 and A3 (err1 \leftrightarrow err3; MI = 27.184); P2 and C5 (err8 \leftrightarrow err16; MI = 26.780); A4 and P4 (err4 \leftrightarrow err10; MI = 23.364); A6 and C5 (err6 \leftrightarrow err16; MI = 22.486). The model still did not demonstrate a satisfactory fit $\chi^2(405.425/96) = 4.223, p < .00$; RMSEA .116 SRMR .110; CFI .826; PNFI .629. Figure 4.6 presents the model fit with the correlated error terms.

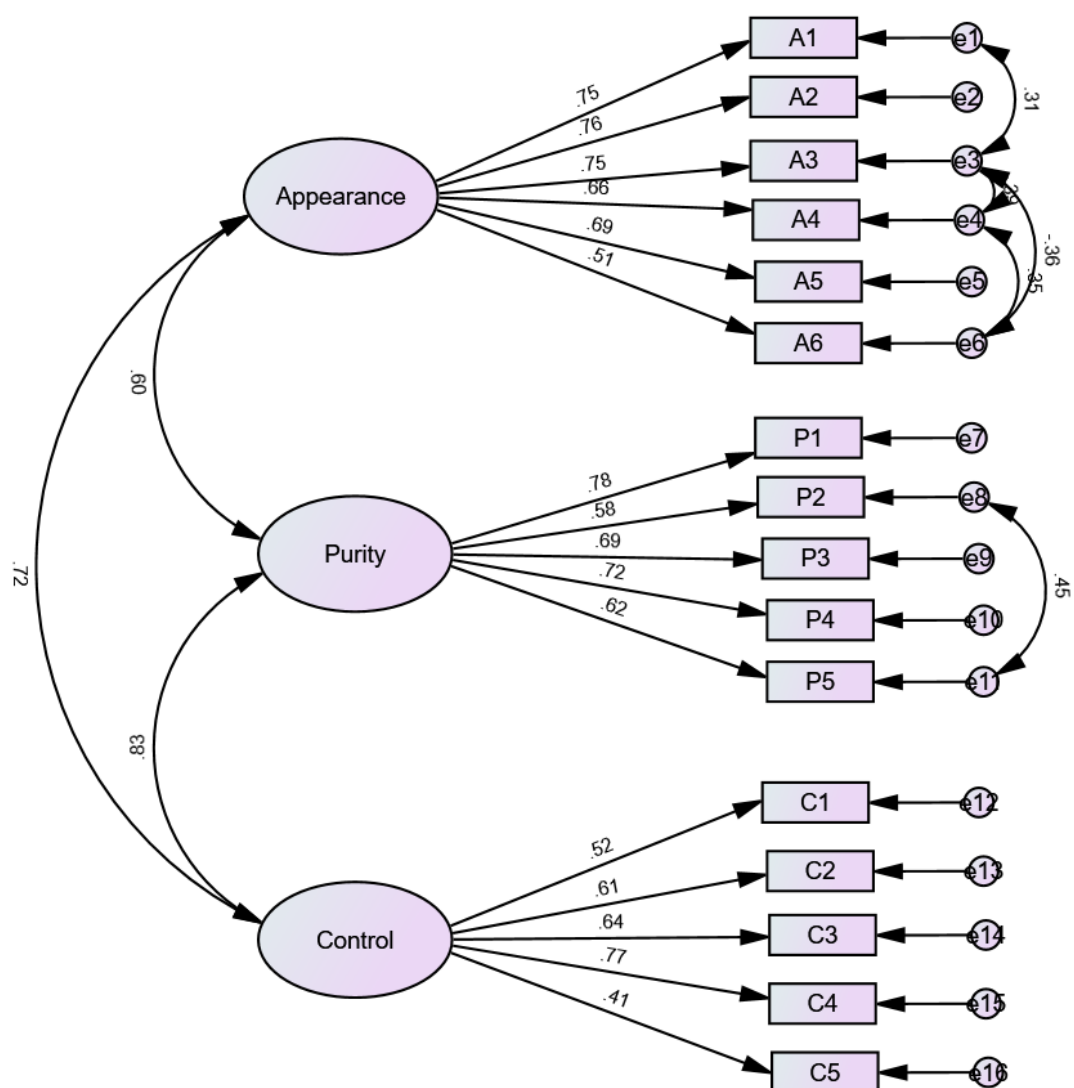


Figure 4.6. CFA 3-Factor Structure Goodness-of-Fit Model with independent sample.

Reliability. Internal consistency of the 16 items version of the scale in this study was good .89, with subscale alphas .84 for “Appearance”, .86 for “Purity”, and .72 for “Control”.

Short version of the scale. The decision to attempt to test if a single factor shorter version of the scale could be a viable solution was made post hoc observing the model fit of the 16-item version. Several items in the 16-item version of the scale demonstrated high modification indices, which in general suggests that these items are involved in some covariances that are not explained well by the current model. In particular, modification indices of items A1, A3, A4, A6, which share the same latent factor, suggest an additional relationship above their loadings on “Appearance”. In addition, A3, A4, A6 items showed high modification indices with more than one other item suggesting an additional covariances with items measuring purity of the diet (A4 and P4) and items measuring the control dimension (A6 and C5). Purity dimension also contained items with high modification indices suggesting an additional covariance with items on the control dimension (P1 and C2, P2 and C5) and with items on the same variable (P2 and P5). The short version of the scale consisted of items that did not demonstrate multiple modification indices with values >20 . This version represents an alternative to the 16-item version consisting of three subscales and includes only one hypothetical dimension underlying all items – ON; and consisted of items A1, A2, A5, P3, P5, C1, C3, and C4.

Initially, model fit indices were below the recommended values, $\chi^2(92.50/20) = 4.63, p < .00$; RMSEA .123 SRMR .064; CFI .872; PNFI .603. Modification indices were examined for values above 10 and associated error terms were allowed to correlate ($e1 \leftrightarrow e2$, MI = 19.159; $e1 \leftrightarrow e8$, MI = 15.585; $e1 \leftrightarrow e3$, MI = 15.141; $e2 \leftrightarrow e7$, MI = 13.808).

The model fit indices improved after allowing for the correlation of the error terms, $\chi^2(92.50/20) = 4.63, p < .00$; RMSEA .123 SRMR .064; CFI .872; PNFI .603.

Figure 4.7 below presents the model fit.

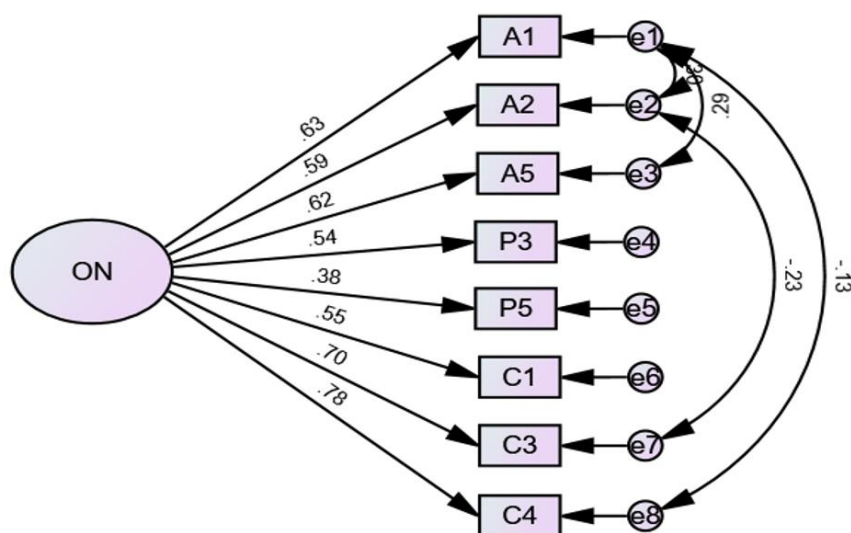


Figure 4.7. CFA 1-Factor Structure Goodness-of-Fit Model of the short version of the scale.

The 8-item scale demonstrated a very good reliability internal consistency expressed as Cronbach's alpha coefficient of .82.

Validity. Table 4.8 presents correlations between the scale total (16 items), short version of the scale (8 items), subscales' scores and the questionnaires administered to assess the discriminant validity.

Table 4.8*Correlation coefficients between the measures.*

Measures	Scale (16 items)	Scale (8 items)	Appearance (subscale)	Purity (subscale)	Control (subscale)
EAT-26	.365*	.454*	.392*	.135*	.388*
OCI-R	.129*	.179*	.033	.082	.233*
MBSRQ-AO	.323*	.344*	.288*	.213*	.238*

Note: Coefficients marked with * are significant at $p < 0.01$ level.

As predicted, Appearance subscale moderately correlated with EAT-26 ($r = .392$) and with the MBSRQ-AO ($r = .288$), Purity subscale and EAT-26 demonstrated a small correlation ($r = .135$), and small correlation was observed between Control subscale and OCI-R ($r = .233$). The 16-item scale was correlated with measures of eating pathology (EAT-26, $r = .365$), obsessive-compulsive tendencies (OCI-R, $r = .129$) and a measure of extent to which one is invested in one's appearance and grooming behaviours (MBSRQ-AO, $r = .323$). The short (8-item) version of the scale has also demonstrated significant correlations with the measures (EAT-26, $r = .454$; OCI-R, $r = .179$; MBSRQ-AO, $r = .344$).

Comparison of group means. One-way ANOVA indicated a significant difference between the groups on their performance on the 16-item scale, $F(5, 235) = 6.8, p = .0001$. A Gabriel's *post hoc* procedure revealed that the group with suspected ON scored significantly higher ($p = .0001$) than individuals in the control group and individuals with reported physical ailment ($p = .021$). There was no statistically significant difference between the group with suspected ON and those

following a religious diet ($p = .073$), individuals that reported to having been diagnosed with an eating disorder ($p = .094$), and individuals that maintain their weight for professional reasons ($p = .190$).

For the short version of the scale (8 items), ANOVA also indicated a significant difference between the groups' scores, $F(5, 235) = 9.34, p = .0001$. Gabriel's procedure indicated that the group with suspected ON scored significantly higher than all other groups (physical ailment $p = .0001$; religious diet $p = .010$; eating disorder diagnosis $p = .034$; weight maintainers for professional reasons $p = .047$; and control group $p = .0001$).

There was a significant difference between groups' scores on "Appearance" subscale $F(5, 235) = 4.571, p = .001$. Gabriel's post hoc procedure indicated that the group with suspected ON scored significantly higher than individuals with physical ailments ($p = .027$) and individuals in the control group ($p = .0001$). There was no significant difference between the group with suspected ON and observers of religious diets ($p = .051$), individuals with self-reported eating disorder diagnosis ($p = .193$), and those maintaining weight for professional reasons ($p = .452$).

ANOVA indicated a significant difference between groups on "Purity" subscale, $F(5, 235) = 3.291, p = .007$. Gabriel's test demonstrated that the group with possible ON scored significantly higher than the control group ($p = .004$). There was no statistically significant difference between the group with possible ON and the rest of participants (physical ailment, $p = .992$; religious diet, $p = 1.00$; eating disorder diagnosis, $p = .870$; weight maintainers for professional reasons, $p = 1.00$).

There was a significant difference between groups on the "Control" subscale's scores, $F(5, 235) = 8.391, p = .0001$. Individuals with possible ON

scored significantly higher than all other groups (physical ailment, $p = .002$; religious diet, $p = .011$; weight maintainers for professional reasons, $p = .004$; and control group, $p = .0001$) but the group of individuals that self-reported eating disorder diagnosis ($p = .061$). Table 4.9 presents means and standard deviations for all groups' post-hoc comparisons.

Table 4.9

Post-hoc comparisons of groups' scores.

Group	16-items	8-items	Appearance	Purity	Control
BOT	M = 60.86 (SD = 12.94)	M = 30.20 (SD = 7.41)	M = 25.64 (SD = 5.56)	M = 17.43 (SD = 5.18)	M = 17.80 (SD = 4.88)
Medical	M = 51.64 (SD = 12.06)	M = 23.19 (SD = 5.84)	M = 21.55 (SD = 4.97)	M = 16.21 (SD = 5.74)	M = 13.88 (SD = 4.35)
Religious diet	M = 51.97 (SD = 11.41)	M = 24.38 (SD = 6.42)	M = 21.41 (SD = 5.64)	M = 16.55 (SD = 4.72)	M = 14.00 (SD = 4.22)
ED	M = 53.00 (SD = 14.71)	M = 25.46 (SD = 8.08)	M = 22.41 (SD = 6.62)	M = 15.71 (SD = 5.56)	M = 14.88 (SD = 5.17)
Prof. reasons	M = 53.93 (SD = 14.74)	M = 25.73 (SD = 7.92)	M = 23.00 (SD = 6.78)	M = 16.76 (SD = 5.47)	M = 14.18 (SD = 5.09)
Control	M = 44.23 (SD = 12.42)	M = 20.08 (SD = 6.22)	M = 19.70 (SD = 6.2)	M = 13.18 (SD = 4.33)	M = 11.35 (SD = 3.83)

Note: M – mean scores; SD – standard deviation values; BOT - individuals that scored at least 5 points on BOT scale; Medical - individuals that reported to have a medical condition (e.g. diabetes, irritable bowel syndrome) that impacts on their daily diet; Religious diet - those following a

religious diet (e.g. kosher, halal, Eastern Orthodox); ED - individuals self-identifying as having been diagnosed with an eating disorder; Prof. reasons - individuals that follow a specific diet to maintain their weight for professional reasons (athletes, models); Control - a group of healthy adults that do not self-identify with any of the above criteria.

Accuracy of the three subscales and 16- and 8- item versions of the questionnaire. The area under the ROC curve (AUC) for the three subscales, for the 16-item and for the 8-item questionnaires differed significantly from .50 (Appearance, $p < .0001$; Purity, $p = .001$; Control, $p < .0001$; 16-item version, $p < .0001$); short version, $p < .0001$). All measures were able to predict possible ON status among the control group and those who responded affirmatively to at least five statements out of six of the BOT. Figure 4.8 presents the ROC curves for the subscales and the short version.

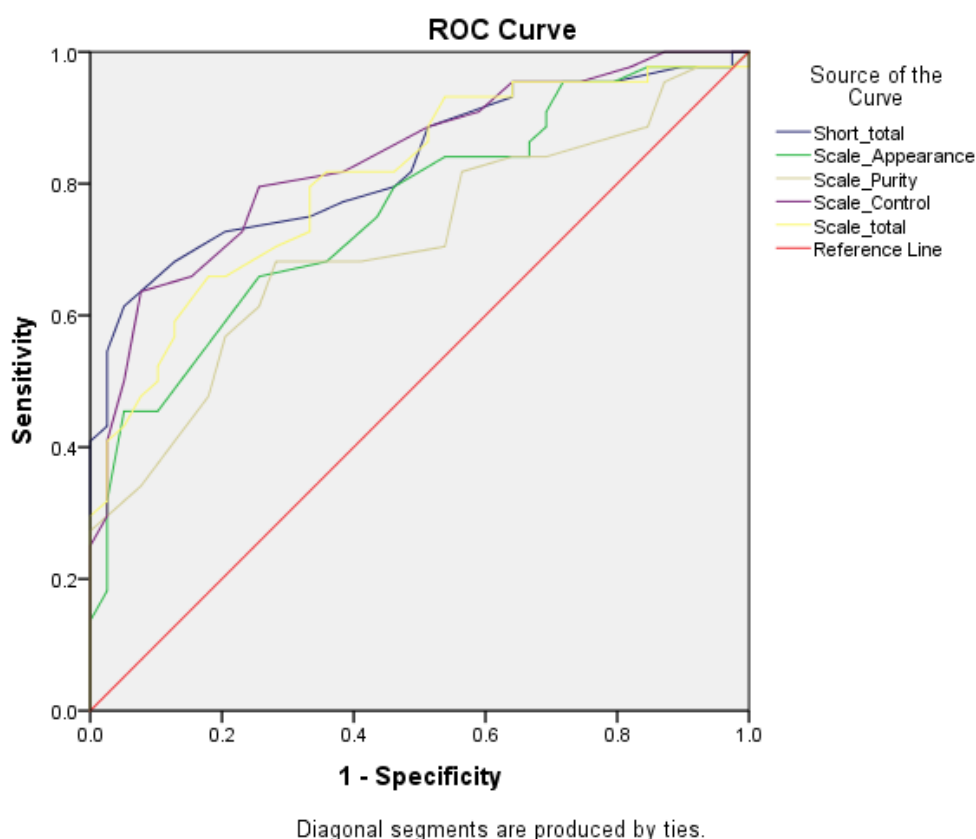


Figure 4.8. ROC curves of “Appearance”, “Purity”, “Control” subscales, full and short versions of the questionnaire to predict possible ON between the control group and individuals that scored at least 5 points on BOT.

Sensitivity and specificity. The short version of the scale ($AUC = .830$, $SE = .045$, 95% confidence interval of .741-.918) performed better than the 16-item scale distinguishing between those with possible ON and the control group. The likelihood of a randomly selected individual from the ON group to score above the cut-off point on the short version of the scale than a randomly selected individual from the control group would be 83% of the time. The AUC of the 16-item scale was .808 ($SE = .047$, 95% confidence interval of .715-.900), which translates into the likelihood of 80.8% of the time randomly selected individual from ON group scoring higher (above the cut-off) than a randomly selected individual from the control group. The AUC of “Appearance” subscale was .757 ($SE = .052$, 95% confidence interval of .655-.860), for “Purity” AUC was .710 ($SE = .057$, 95% confidence interval of .599-.821), and for “Control” AUC was .837 ($SE = .043$, 95% confidence interval of .751-.922).

Cut-off scores. To allow for flexibility in application of the scales, three cut-off points were selected for each scale/subscale. The first cut-off point (A) was selected prioritising specificity over sensitivity. The second cut-off score (B) was selected to reflect the balance between specificity and sensitivity. The third cut-off point (C) prioritises sensitivity over specificity. In addition, true and false positive rates and positive and negative likelihood ratios were calculated for each scale and cut-off point. Table 4.10 presents the results of these calculations.

Table 4.10

Cut-off values and associated calculations for all scale variations.

Scale	Cut-off	Cut-off value	Sensitivity	1-Specificity	TPR	FPR	PLR	NLR
16-items	A	64	.409	.026	.947	.015	15.73	.064
	B	50.5	.818	.359	.720	.424	2.28	.439
	C	20.5	.886	.513	.531	.19	1.73	.579
8-items	A	28.5	.614	.051	.931	.037	12.04	.083
	B	25.5	.727	.205	.800	.186	3.55	.282
	C	20.5	.886	.513	.661	.833	1.73	.579
Appearance	A	27.5	.455	.051	.909	.033	8.92	.112
	B	24.5	.659	.256	.746	.227	2.57	.388
	C	20.5	.841	.538	.638	.600	1.56	.640
Purity	A	17.5	.568	.205	.758	.160	2.77	.361
	B	15.5	.682	.282	.732	.262	2.42	.413
	C	12.5	.818	.564	.621	.880	1.45	.689
Control	A	15.5	.659	.154	.829	.125	4.28	.234
	B	13.5	.795	.256	.778	.263	3.11	.322
	C	9.5	.955	.641	.627	1.56	1.49	.671

Note: TPR = true positive rate; FPR = false positive rate; PLR = positive likelihood ratio; NLR = negative likelihood ratio.

True positive rates can be described as a proportion of individuals with a known positive condition, in this case those that scored at least five points on the BOT, scoring above the cut-off point on the new measure. False positive rate is the proportion of cases with a known negative condition (individuals in the control group) that were identified as positive by the new scale. Considering the cut-off points “B” in the table above 8-item scale demonstrated a better performance than

the 16-items scale identifying 80% of individuals in the ON group as having the diagnosis compared to 72% (16-items). Also, 8-item scale's false positive rate for cut-off point B was lower than the one for 16-item's scale. Short version of the scale has also demonstrated a higher positive likelihood ratio at cut-off "B", which translates to higher odds (3.55 times more likely) individuals who scored above the cut-off point to actually have ON. In addition, 8-item measure demonstrated a lower value for the negative likelihood ratio (cut-off B) than the 16-item scale. Negative likelihood ratio indicates a change in odds of identifying ON diagnosis when an individual scores below the cut-off point. The lower the value the more informative the scale. It's worth noting that the difference between the negative likelihood ratios in a desired direction was observed only at cut-off "B" while the negative likelihood ratios of the two versions did not differ for cut-off "C" and 8-item scale had a higher value at cut-off "A" than the long version.

4.6 Study 4

Aim. The aim of this study was to examine the test-retest reliability of the two (16-items and 8-items) scales developed in the previous study.

Participants. The sample intended for this study included all participants from the control group and the group of individuals that self-identified with BOT statements and participated in the previous study ($n = 83$). However, not all individuals responded to the "call" for participation and the final sample consisted of 71 individuals, 34 participants representing healthy and 37 self-identified with BOT groups.

Recruitment. Recruitment process was identical to the one employed in Study 3 of this chapter and took place using Prolific data base. Participants received

monetary compensation for their participation (average reward per hour = 18.75£).

Recruitment for this phase took place three weeks after completion of Study 3.

Measures. Participants were asked for their Prolific ID to match their data to their initial scores. The measure included only the 16-item scale developed in the previous study.

Statistical analysis. Pearson correlation coefficients were calculated between the composite scores of the 16-item and 8-item scales from Study 3 and this study. Test-retest reliability coefficients vary from 0 to 1 where 1 is considered a perfect reliability, $> .75$ an excellent reliability, from $.60$ to $.74$ as good, and from $.40$ to $.59$ as fair (Cicchetti, 1994).

Results

A good test-retest reliability was observed between the scores of the control group on the 16-item scale, $r = .609$, $p = .01$, while the 8-item scale's test-retest reliability was $r = .604$, $p = .01$. Scores of the group with possible ON of the 16-item scale showed a good test-retest reliability ($r = .605$, $p = .01$) a similar observation was made for the 8-item scale ($r = .660$, $p = .01$). However, the discrepancy between the number of cases scoring above the cut-off point in the previous study and in this one was very small. The discrepancy for the 16-item scale was only one case and two cases for the 8-item questionnaire.

Discussion

The aims of Study 3 and 4 in this chapter were: to confirm the three-factor structure of the scale under development, to examine convergent, discriminant validity and internal reliability of the measure, to establish the cut-off scores, and to assess its test-retest reliability. The 16-item scale was named Screening Tool for

Orthorexia Nervosa (STONE). The short, 8-item version was termed Screening Tool for Orthorexia Nervosa – Short (STONE-S). The scales will be referred to by their respective acronyms in the discussion and subsequent work.

STONE and the three subscales. The three-factor model did not demonstrate an acceptable fit to the data. This might have occurred due to the cross loadings of the items retained via EFA on more than one factor suggesting that items reflect more than one theoretical dimension of ON, which could be resulting from the lack of clarity in items' wording. For example, item "Other people have mentioned that my diet is too restrictive" refers to two theoretical dimensions related to ON. One could either understand that this item describes the rigidity of one's dietary intake or pertains to evaluation of one's diet by his/her immediate social circle. Initially, this statement was developed to represent an impact of ON on individuals' social life and loaded with the statements representing control at a later stage of the analysis.

Despite the poor model fit, internal consistencies of the scale and of the three subscales ranged from acceptable to very good. The scale correlated with measures of eating pathology, obsessive-compulsive tendencies, and a measure of investment in one's appearance in a predicted direction. The correlation coefficients, however, were weak. Considering the existing research (e.g. Brytek-Matera et al., 2017) associations between measures of ON and the measures of eating pathology and obsessive-compulsive tendencies are not surprising. In addition, stronger associations, represented by higher correlation coefficients, would suggest that ON might be a variant of the existing conditions rather than a stand-alone diagnosis. In this study, weak correlations point out that ON is a complex condition that shares some of the features of OCD and eating pathology but could be a unique diagnosis.

Discriminant validity of the subscales was assessed via associations with other key variables. As predicted, the “Appearance” subscale correlated with measures of eating pathology and investment in one’s appearance while the association with the measure of obsessive-compulsive tendencies was not significant. The items of this subscale were developed to represent the motivation for weight maintenance and desire to improve one’s physical appearance via adherence to a “healthy” diet, which was overlooked in the diagnostic criteria proposed by Dunn and Bratman (2016) but emerged as one of the themes of the qualitative interviews in Chapter 3. Correlation coefficients were significant but small, suggesting a weak association which points to the presence of concerns about one’s appearance in ON, however, these concerns might be different to the body image issues experienced by individuals suffering from AN or bulimia (Cash & Deagle III, 1997).

The “Purity” subscale demonstrated a similar pattern of associations with other measures. Significant correlations were observed between this subscale and the measure of eating pathology and appearance orientation subscale of the MBSRQ questionnaire. Items in the subscale pertain to specific avoidance of foods that are deemed “unhealthy” or lack “purity” and were developed based on the findings from both nutritional exploration and qualitative data studies in Chapter 3. While the drive for weight maintenance and rigid behavioural control may be present in other pathological conditions (e.g. AN and OCD), avoidance of foods deemed to lack purity is one of the distinguishing features of ON, which the “Purity” subscale was developed to represent. Not all items of this subscale, however, represented purity of the diet exclusively. One item (My diet has more health benefits than other diets) taps not only in a desire for “pure” nutrition but also suggests an attitude of superiority of individuals who allege pure diet over those that do not follow their

dietary rules. This moral superiority has been suggested to be one of the ON features (Dunn & Bratman, 2016) but other relevant items were eliminated during the EFA in the previous study. To improve the scale, future work might benefit from adding more items that are clearly worded to represent this dimension of ON. Significant association between EAT-26 and “Purity” subscale can be explained by the similarity between some of the items in both scales describing restricting one’s dietary intake, albeit the different reasons for restriction (purity of food in ON vs food perceived as fattening in EAT-26) both scales involve measuring behaviours of restricting one’s food intake. The correlation coefficient was, however, weak suggesting that despite the similarities “Purity” subscale measures theoretical dimension unique to ON.

Interestingly, the “Purity” subscale has also demonstrated a significant association with the measure of extent of investment in one’s appearance. One possible explanation for this association may be related to enhancing one’s physical appearance as one of the reasons individuals cite for adherence to a “healthy” diet. In other words, pure diet is instrumental in achieving or maintaining a self-defined standard of physical appearance. Another possible explanation is that the same psychological variable underlies both behaviours, looking after one’s appearance and looking after one’s dietary intake. In fact, one of the proposed diagnostic criteria for ON (Dunn & Bratman, 2016) refers to a sense of self-worth and identity depending on the adherence to a “healthy” diet. It could be that the underlying characteristic behind attention to grooming and diet is a personality trait. In fact, perfectionism has been associated with body image, eating disorder symptoms (Zoletić & Duraković-Belko, 2009), and ON (Barnes & Caltabiano, 2017). Personality traits were not

assessed in this study and to further explore the performance of the “Purity” subscale, future studies should explore its association to perfectionism.

The third subscale, “Control”, was related to all three measures (EAT-26, OCI-R, and MBSRQ-AO). The items in this subscale describe a behavioural preoccupation with the subject of nutrition and restrictive practices surrounding food consumption and preparation. Association with the measure of obsessive-compulsive tendencies was predicted initially. People scoring above the cut-off point on OCI-R questionnaire and on the “Control” subscale would display obsessions with nutrition and compulsive tendencies surrounding eating behaviour. This significant association offers evidence for the validity of this subscale.

Associations with EAT-26 and MBSRQ-AO in this study were unexpected. One explanation for the correlation between eating pathology and “Control” could lie in the commonly observed comorbidity of obsessive-compulsive tendencies, eating pathology and ON (McComb & Mills, 2019). In addition, established eating disorders such as AN and bulimia frequently co-occur with the obsessive-compulsive tendencies (Meier et al., 2019). The nature of the association between the subscale and the EAT-26 could also be stemming from the sample characteristics. Participants were selected from the data base collected for unrelated research projects. Some participants in the group that self-identified with at least five BOT statements as well as individuals in the group that reported an eating disorder diagnosis indicated an OCD diagnosis in the past. On one hand this could limit the interpretation of the current findings, while on the other it shows ON as a complex phenomenon that seems to underlie several known pathological conditions.

The “Control” subscale was also associated with the appearance orientation subscale of the MBSRQ. This association was not in line with initial predictions. However, existing studies using other measures of ON reported a similar trend, which suggests that exaggerated focus on appearance might be a hidden motive behind the drive for “healthy” nutrition (Barnes & Caltabiano, 2017) and rigid behaviours are instrumental in achieving the desired control over one’s dietary intake.

STONE-S. Interestingly, after eliminating items with high MIs, a short version of the scale demonstrated a good model fit and results supported the internal consistency. The items included in the scale were hypothesised to represent a single construct and correlated with the measures of eating pathology, obsessive-compulsive tendencies, and investment in appearance offering evidence for the scale’s discriminant validity. STONE-S demonstrated a better performance than the 16-item version and individual subscales differentiating between groups’ scores. A group of individuals self-identified with BOT statements scored significantly higher on the short scale than all other groups. In addition, results of the ROC analysis suggest that this version of the scale demonstrated a higher likelihood of distinguishing those with ON than the 16-item version.

Cut-off scores. ROC analysis identified three possible cut-off points for each version of the scale, which was done considering the various options for the application of the measures. In practice, scales that are highly sensitive run a risk of identifying false positive cases, while high specificity entails a risk of missing true positive cases (Akobeng, 2007). The first cut-off value (A) was set prioritising specificity over sensitivity and could be used in research scenarios when high

importance is placed on ON status as an inclusion criterion. Using cut-off score “A” could potentially ensure exclusion of false positives from the ON sample.

The second cut-off score (B) was set to represent a reasonable balance between sensitivity and specificity. In this study, application of cut-off of 50.5 for the 16-item scale resulted in identifying 36 out of 44 individuals in the ON group, which implies the ability to predict ON status with sensitivity of 81.8% and specificity 64.1%. For the short scale, the cut-off value of 25.5 identified 32 out of 44 individuals in the ON group implying the ability to predict ON status with sensitivity of 72.7% and specificity of 79.5%.

The third cut-off score (C) was set prioritising sensitivity and could be used in cases when the scale is used to identify individuals at risk of developing ON. In practice, this cut-off score would be useful for screening individuals involved in disciplines or occupations (e.g. modelling, bodybuilding) where circumstances might accentuate their ON tendencies which might have an adverse consequence for individuals’ health. This could constitute a preventive tool against the development of pathological eating behaviour.

Test-retest reliability. Coefficients indicating the test-retest reliabilities for the 16-item and 8-item scales were good according to Cicchetti (1994). Other authors suggest a more conservative interpretation of the coefficients. For example, Portney and Walkins (2015) proposed values from .50 to .75 to represent poor to moderate test-retest reliability, from .75 to .90 good, and > .90 acceptable. According to this interpretation test-retest reliability of both versions of the scale could only be moderate.

Classification. The scales identified some false positives in both Study 3 and 4 of this chapter. In study 4 though there were more false positives identified by both versions of the scale. To estimate classification and misclassification rates the cut-off “B” was used for both versions as it was set to represent the balance between sensitivity and specificity. Table 4.11 below presents the true positive/negative and false positive/negative rates from Study 3 and 4. Because of the unequal sample sizes in the two studies, presented values are presented in percentages.

Table 4.11

Percentage of participants scoring above the “B” cut-off point in Study 3 and 4.

		Study 3		Study 4	
		True positive (BOT)	True negative (BOT)	True positive (BOT)	True negative (BOT)
Full Scale (16 items)	Predicted positive	81.82%	35.90%	89.19%	44.12%
	Predicted negative	18.18%	64.10%	10.81%	55.88%
Short scale (8 items)	Predicted positive	72.73%	20.51%	81.08%	32.35%
	Predicted negative	27.27%	79.49%	18.92%	67.65%

This discrepancy could have resulted from the change in eating behaviours of individuals in the control group. However, life changes were not assessed in the retest phase which limits the ability to interpret the results. Test-retest has also revealed that there were more people in the group of individuals scoring high on BOT obtaining scores above the cut-off point on the scale at the retest phase. Kline (2000) suggested several factors affecting test-retest reliability. One factor that could account for the low coefficients in this study is the small sample size. A sample should contain at least 100 individuals to minimise the standard error of the

correlations (Kline, 2000). In the future, test-retest reliability should be reassessed using a sufficiently large sample size.

Strengths and limitations. The scales developed in this chapter offer alternative instruments to assess ON and before discussing the limitations of these studies several advantages are worth mentioning. The structure of the scales was explored using a sample of individuals that self-identified with the BOT statements, which were developed based on the diagnostic criteria and ON definition proposed by Bratman in contrast to most studies that attempted to develop diagnostic tools for ON used student samples (Donini et al., 2005; Barrada & Roncero, 2018; Gleaves et al., 2013) and cite their sample characteristics as one of the limitations in their designs. Another advantage of the developed instruments is that all items were developed based on the qualitative interviews with and exploration of dietary intakes of individuals displaying orthorexic tendencies. This method was not previously utilised in the development of existing measures. For example, for the development of the EHQ scale items were generated based on the Bratman's case studies and were agreed on via consultation with graduate researchers familiar with the symptoms of ON. Generating items informed by the individuals in particular behavioural circumstances, however, offers a chance to ground the concept of ON in real-life observations and enhance the quality of the measure (Rowan & Wulff, 2007).

There are some limitations to the developed measures worth noting. First, both, long and short, scales do not capture negative affect and physical impairment dimensions of ON proposed by Dunn and Bratman (2016). The items capture behavioural and motivational aspects of ON but it would not be possible to assess whether hypothesised orthorexic behaviours cause any impairment in individual's social or occupational functioning. Also, application of the scale alone would not be

sufficient to identify whether adherence to self-defined “healthy” diet causes any adverse physical consequences (e.g. malnutrition). Statements reflecting social impairment and compensatory behaviours were included in the process of development but were eliminated from the scale during the EFA. One direction for future research would be to generate and test clearly worded items reflecting these factors.

Second, concurrent validity of the scales was not evaluated in the series of studies described in this chapter. Considering that independently developed questionnaires measure the same construct, in the future, the scale’s performance needs to be evaluated with the existing measures of ON (e.g. EHQ, TOS). It would be particularly informative to compare the scales’ performance with the TOS (Barrada & Roncero, 2018). TOS scale claims to differentiate between the drive for healthy diet and the pathological dimension when this drive negatively impacts individual’s functioning. Comparing the scale to TOS would offer additional information on its ability to place individuals on a spectrum from a healthy interest in nutrition to the point where this interest becomes impairing to one’s functioning.

To conclude, this chapter presented a series of studies aiming to develop an independent measure of ON. STONE-S demonstrated a better model fit than the STONE version and was able to better differentiate between the group of individuals with possible ON and all other groups. Future research is needed on both ON and the scale to clarify the nature of this condition.

Chapter 5. Discussion.

ON is a relatively new – and still poorly defined – phenomenon. Despite the growth in the number of studies, there is no consensus on the definition, diagnostic criteria, or diagnostic tools. The aims of this thesis were to explore the concept of ON, investigate the most widely used diagnostic tool, examine the dietary intakes of individuals with possible ON, investigate the experience of this condition qualitatively, and to develop a new diagnostic tool that could contribute to research on ON.

Diagnostic criteria and definition. One of the challenges, and perhaps the most important one, facing all research on ON is uncertainty about its place as a distinct mental illness. According to Robin and Guze (1970), it is imperative that a proposed diagnosis for a mental disorder is validated via a series of steps. The first step is to provide a precise clinical picture of the disorder. For ON, several sets of diagnostic criteria have been proposed (Cena et al., 2019), but the agreement on all its features is yet to be reached. One of the aims of this thesis was to clarify what experiencing ON involves from the perspective of those displaying orthorexic tendencies. When comparing current results with the proposed criteria several discrepancies have emerged. One of which is regarding the allegedly negative impact of ON on individuals' social lives. Adherence to “healthy” diet was suggested to result in social isolation (Dunn & Bratman, 2016). Results of this work, however, speak to the contrary. In contemporary society, concern with healthier lifestyle and nutrition is a widespread phenomenon (La Berge, 2008; Lupton, 2000) which suggests that individuals striving for health are more likely to find themselves in the company of likeminded people than experience social isolation. In line with this reasoning results of the qualitative interviews (Chapter 3) suggested that individuals

displaying ON symptoms seek social connections with others applying similar values to food consumption which renders social isolation as a defining feature of ON obsolete. Another discrepancy between the diagnostic criteria and results of this thesis concerns the role of weight management as a motivating feature. Desire for weight management was suggested to be the feature that differentiates ON from established conditions (e.g. AN). To the contrary, results of two studies in this thesis (Study 1 chapter 3 and Study 1 chapter 2) highlight weight management as one of the main motivating factors behind adherence to self-defined healthy diet. Taken together the work in this thesis suggests that the first step in a series of steps (Robin & Guze, 1970) is yet to be achieved.

ORTO-15. The second step suggested by Robin and Guze (1970) should involve laboratory studies. In the context, psychological tests if reliable and reproducible can also be considered to represent this step (Robin & Guze, 1970). This step also includes development of diagnostic tools. In the context of ON, several attempts were made to develop diagnostic measure of ON but consensus is yet to be reached. In addition, no laboratory test exists for assessment of ON. Evaluation of the most popular questionnaire used in academic publications offered further support for frequently cited limitations of the tool. Most studies that attempted to convey the criticism of ORTO-15 focused on testing its psychometric properties (Rogoza, 2019; Moller et al., 2019; Heiss et al., 2019;) or trying to identify/confirm its factor structure. Whereas it is informative to assess the psychometric properties of the scale, no studies to date have explored what could be wrong with the items qualitatively. Study 1 in Chapter 2 was designed to fill this gap utilising the “think aloud” method. Examination revealed that people struggle to understand the meaning of the questions and criticise the scale for poor wording. In

addition, participants in Study 1 (Chapter 2) struggled to understand the relevance of some items not just to the concept of eating behaviour but questioned the items in terms of every-day functioning. Investigation into the limitations of ORTO-15 was imperative as one might question the validity of the knowledge obtained in the last two decades when this questionnaire was used. Results of examination of ORTO-15 questionnaire in Chapter 2 suggested that new independent tools are needed.

The lack of a robust diagnostic tool for ON is not surprising considering the absence of clear definition and agreement on whether this is a stand-alone condition or a variant of a recognised eating disorder (AN) or an obsessive-compulsive disorder that happens to focus on eating behaviour (Brytek-Matera et al., 2017). Cena et al. (2019) reviewed diagnostic criteria proposed by several authors (Barthels et al., 2015; Dunn & Bratman, 2016; Moroze et al., 2015) and suggest that the common features include: obsessive preoccupation with healthy nutrition, negative affect caused by non-adherence to self-imposed dietary rules, psychosocial impairments in every-day functioning, malnutrition and subsequent weight loss. Most existing studies focus on investigations of psychological impact of ON, very few studies have attempted to explore the extent of malnutrition in individuals exhibiting orthorexic tendencies. The pilot study (Chapter 3) of micro- and macronutrient intakes provided new insight into the diets of those alleging the healthy properties of their chosen diets. Dietary patterns associated with other eating disorders are well researched (e.g. Huse & Lucas, 1984). One would expect, if ON is in fact a new eating disorder, to find a pattern of food consumption, or rather avoidance, associated with perceived “healthy” properties of foods among the individuals with possible ON. Results, however, indicated a great disparity in participants’ dietary contents and were in line with the description of ON provided

by Bratman (2000) in his book. He outlined that the definitions of a “healthy” diet differed among his patients. One interesting finding was self-reported rigidity in participants’ diets. Individuals reported very little variation in their diets which indicates the 24-hour recall method as an appropriate procedure for the future explorations of dietary intakes of individuals exhibiting orthorexic tendencies. In fact, examining macro- and micronutrient intakes associated with ON should be extended to a larger sample in the future. Investigating the impact of ON on dietary intakes would clarify whether malnutrition is in fact a feature of this condition and could be used as one of the diagnostic criteria.

Qualitative explorations of individuals’ experiences of this condition offer further support for describing ON as a highly individual and complex condition. There were some similarities among participants’ accounts. For example, strive to enhance/maintain one’s appearance seemed important to participants in Study 1 (Chapter 3) and in the “think aloud” sample. This could be viewed from two perspectives. On the one hand, it indicates that motivation for weight loss and “clear” skin might be an important feature of ON, on the other hand, however, this could have resulted from the sample characteristics. Six individuals out of ten that were interviewed were involved in occupations where their professional success depends on their physical appearance. More research is needed to ascertain whether desire to enhance physical appearance can be considered for inclusion in the diagnostic criteria. In the future, qualitative studies should aim to engage with individuals that do not experience occupational pressures to maintain a certain standard of physical appearance.

Another prominent feature discovered by both “think aloud” and qualitative interview techniques was the participants’ strive for control of their diet that seemed

to influence other areas of their functioning. The finding of this study is in line with existing qualitative research. The role of perceived control has also been explored by a qualitative exploration of blog entries of individuals (bloggers) self-identifying with ON (Greville-Harris et al., 2019). Issues of personal control are not uncommon among individuals diagnosed with AN or BN (Williams et al., 1993) and were proposed to play a role in maintenance of AN (Bruch, 2001). For participants in this research (Chapter 3), increased control over their diets was prompted by the changes in their lives, which is very similar to the experiences described in terms of AN whereby changes in personal circumstances often cause a sense of uncertainty. In this case, control over eating behaviour is a successfully executed behaviour which is much easier to achieve than master control over other areas of functioning (Slade, 1982). Many patients suffering from AN recall the onset of restricting their food intakes at times when life was chaotic and perceived out of their control (Patching & Lawler, 2009). Perhaps, the strive for control is at the heart of the commonly cited similarity between ON and AN as both groups describe the onset at times of their lives when feeling out of control. However, despite the theoretical and qualitative link between ON and control more research is needed to establish which theoretical concept of control is relevant to ON. Multiplicity of concepts have been used to define “control” as a psychological variable. For example, locus of control, personal control, sense of control, fear of losing control, mastery are all conceptualisations of control that might be interrelated but have produced different results in relation to recognised eating disorders (Froreich et al., 2016). In particular, Froreich et al. (2016) suggested that fear of losing self-control and ineffectiveness are two conceptualisations of control relevant to maintenance of eating disorder symptoms. One obvious direction for future research would, therefore, be to investigate whether

these dimensions of control are relevant to ON, which would aid in clarifying the diagnostic criteria of this condition.

STONE and STONE-S. STONE is a 16-item multidimensional measure of ON. Components include three subscales “Appearance”, “Purity”, and “Control”. The scale was developed based on the following conceptualisation of ON: (1) physical appearance is the main motivation behind individuals’ restrictions on their diet, (2) dietary intakes are characterised by avoidance of foods perceived as “unhealthy” or “impure”, (3) in order to achieve “pure” diet individuals are preoccupied with searching for nutritional information and apply increased scrutiny to food preparation and food shopping. To be identified as displaying orthorexic tendencies, one has to obtain high scores on all three subscales. According to the likelihood ratios for the cut-off point “B” the scale has approximately 15% increase in probability of a person that has ON to be identified positively by the STONE. When weighting out the positive and negative likelihood ratios, this scale serves as a better predictor of identifying the positive results when ON is present than ruling out ON.

The initial intention was to also include items that assess negative affect, excessive physical activity, and compensatory behaviours resulting from straying off the diet of choice. These items, however, were eliminated as a result of a series of EFAs. One of the challenges in defining ON has always been to identify at which point does the desire to eat a healthier diet becomes pathological. Therefore, a measure of ON should be able to distinguish between the pathological obsession and a strive for healthy nutrition.

STONE-S included 8-items and is a unidimensional measure of ON. This scale is based on the same conceptualisation of ON as the long version and includes items representing all three subscales. STONE-S demonstrated a better performance differentiating the ON group from all other groups in Study 3 of the previous chapter. When using the cut-off point “B” of this scale the likelihood ratio and, therefore, probability of identifying a person with ON when it is present was higher than the long version (20%). The scale was still better suited to identify positive cases when ON is present than to rule out the presence of ON. Table 5.1 below presents the final versions of the scale.

Table 5.1

STONE and STONE-S.

Items	STONE	STONE-S
I follow my diet in order not to gain weight.	✓	✓
I eat healthy because I want to improve the way I look.	✓	✓
The main motivation behind my food choices is weight management.	✓	-
My chosen diet has a positive impact on my appearance.	✓	-
My diet is designed to keep me at a specific weight.	✓	✓
My diet is good for my skin.	✓	-
I avoid processed foods.	✓	-
I avoid genetically modified foods.	✓	-
I eat only healthy food.	✓	✓

Table 5.1 Continued.*STONE and STONE-S.*

Items	STONE	STONE-S
My diet has more health benefits than other diets.	✓	-
I avoid foods that were treated with pesticides.	✓	✓
Other people have mentioned that my diet is too restrictive.	✓	✓
I avoid food that I haven't prepared myself.	✓	-
I measure every portion.	✓	✓
I spend a lot of time researching nutritional composition of foods.	✓	✓
It's important for me to know where the food I buy at the supermarket/market comes from.	✓	-

Both, STONE and STONE-S, differ from the existing measures of ON. For example, ORTO-15 (Donini et al., 2005) conceptualise a person displaying orthorexic tendencies measured by their tool as “health fanatic” with obsessive-compulsive tendencies. Research has evolved since the conception of ORTO-15 and studies carried out in this thesis suggest that ON is more complex than the initial description. The EHQ suggests that ON can be measured by evaluating the extent of knowledge of healthy eating, problems with healthy eating, and positive feelings associated with healthy eating. However, the subsequent investigations into the structure of this scale by Oberle et al. (2017) has identified three items that loaded on EHQ-Behaviours subscale instead of the EHQ-Problems subscale (suggested by the

original authors of the questionnaire). In addition, a possible limitation of this questionnaire is that it does not include items reflecting the negative affect possibly associated with ON symptoms (e.g. shame, guilt, self-punishment) that individuals experience when their self-imposed dietary restrictions are violated (Roncero et al., 2017). A recent study by Halim et al. (2020) evaluated EHQ's psychometric properties and its ability to measure ON. The authors concluded that "The EHQ appears to be a better measure of normal healthy eating habits, rather than orthorexic tendencies." (Mohamed Halim et al., 2020, p. 7). Measures developed as part of this thesis add specific items to describe the foods that are considered "impure" by the individuals with possible ON and propose the motivation for the onset and maintenance of ON as being central to this condition.

One promising measure that could potentially be used in conjunction with the developed measure is the TOS (Barrada & Roncero, 2018). Conceptually, this measure suggests the bi-dimensional structure of assessment and when used together with the proposed measure may be useful to differentiate between the stages of ON and aid in exploring the progression of this condition long term.

The test-retest study indicated that the scales identified more individuals scoring above the cut-off point in the group of those scoring high on the BOT than in Study 3 (Chapter 4). This finding was unexpected considering characteristics of ON behaviours discovered in nutritional and qualitative studies (Chapter 3). Individuals described their diets and their behaviours associated with food as stable with little variation. If the behaviours and diets are the same, then what has caused the variation in scores obtained three weeks apart? One possible explanation could be that even though the behaviours may remain stable, their self-perceptions might have changed.

This aspect must be researched further in the future, as to date, studies do not report on progression/development of ON over time.

Some previous attempts to develop a measure for ON were complimented by a set of diagnostic criteria (e.g. BOT, Bratman & Knight, 2000; ORTO-15, Donini et al., 2005; DOS, Barthels et al., 2015). The work in this thesis contributes to the understanding of ON. However, proposing a set of diagnostic criteria based on the factor structure of the developed scale would be premature. Despite the claims that ON has adverse consequences for individuals' health and functioning, the nature of the alleged pathology is yet to be established. Results of studies in this thesis suggest that orthorexic behaviours may be specific to groups of people for whom adherence to allegedly "healthy" nutrition achieves a desired outcome in physical appearance. In the future, one possible direction would be to assess whether ON is manifested in the same manner among individuals who in the past depended on their physical appearance for professional success and no longer do. Assuming one no longer feels the occupational pressure to retain a certain appearance, and if one was truly orthorexic, then their behaviour and attitude towards food would not change.

Recommendations for future application of the STONE and STONE-S scale.

In its current form the developed measures can be used for screening of at-risk individuals. Assessing the scores of the three subscales forming STONE can clarify the nature of ON experienced on individual level. Furthermore, assessments can be tailored to various scenarios based on three suggested cut-off scores for each version of the scale. It would be particularly useful in situations where it is desirable to differentiate between the severity of association with ON symptoms.

Considering the discrepancies observed in the test-retest study, single application of the scale might not be enough to form the diagnosis. It is recommended to assess at risk individuals at two points of time. The scale should be used in combination with anthropometric and nutritional measures. Combining these measures will provide a clearer picture of the level of potential physical impairment caused by ON.

Future research

In the future, research efforts should focus on investigating the micro-macronutrients composition of diets of individuals with suspected ON. Nutritional exploration in Chapter 3 attempted this but the sample size included only ten individuals. To form a more comprehensive picture about the impact of ON on nutrition the study has to be replicated with a larger sample.

More research is needed on the scales developed as part of this work to include the dimensions that will reflect the pathological preoccupation with nutrition and allow for measuring the potentially negative impact of ON on one's functioning. In its current form, both versions (16 and 8 items) might be suitable to identify individuals at risk of ON, but may not be informative in terms of identifying a level of impairment caused by ON. Furthermore, assessing concurrent validity of the scale was not feasible within the timeframe of this thesis and should be examined in the future research.

Conclusion

In conclusion, the results of the studies conducted for this thesis contribute to the understanding of ON as a complex condition by highlighting the variability of reasons stated for adherence to a "healthy" diet. No single pattern of dietary intakes

and high variability of experiences and reasons for choosing the allegedly “healthy” diets were observed in the studies. The developed tool may be used for screening at-risk individuals, but more research has to be carried out to establish the concurrent validity of the measure and test its performance among a diverse range of people.

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Appendix 1

Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity
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ORIGINAL ARTICLE



Does ORTO-15 produce valid data for 'Orthorexia Nervosa'? A mixed-method examination of participants' interpretations of the fifteen test items

Elina Mitrofanova¹ · Elizabeth Pummell¹ · Laura Martinelli^{1,2} · Andrea Petróczi¹

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Abstract

Purpose Orthorexia Nervosa (ON) is defined as a pathological eating behaviour stemming from being “healthy” or “pure”. Survey-based studies typically rely on the ORTO-15 questionnaire or its variations to detect orthorexia. However, frequent post-hoc adjustments to the ORTO-15 suggest psychometric problems. In this study, we explored people's cognitions about the ORTO-15 items to (1) identify problems specific to ORTO-15 items and (2) explore participants' understanding of ON symptoms.

Methods Fifty adult participants (40% male, mean age = 34.0 ± 14.4 years) completed the ORTO-15, the Eating Attitudes Test (EAT-26) and the Obsessive–Compulsive Inventory–Revised edition (OCI-R). Qualitative data were collected using the modified “think aloud” protocol, which asked participants to ‘verbalise’ their responses to the ORTO-15 items. These qualitative responses were first analysed conjunctively with the quantitative responses; then subjected to thematic analysis.

Results ORTO-15 identified 64% of the participants for orthorexic tendencies. In most cases (76%), participants reported no issues completing the ORTO-15. However, in some cases, qualitative responses differed from quantitative ones. When people encountered problems, it was because of poor psychometric construction: lack of clarity, ambiguous wording and multiple statements in a single item. Elaborations around the ORTO-15 items formed four major themes: “preoccupation with physical appearance”, “control”, “food is fuel” and “alone, not isolated”.

Conclusion Even though in the majority of cases there were no issues with completing ORTO-15, thematic analysis revealed several discrepancies between our participants' perceptions of the ORTO-15 items and the previously proposed diagnostic criteria for ON. The results suggest that ORTO-15 is, at best, a mediocre screening tool for ON, which is sensitive to diet but fails to have sufficient level of specificity to detect the pathological stage. More accurate instruments are needed to further research on ON.

Level of evidence V (cross-sectional descriptive study with qualitative analysis).

Keywords Orthorexia · Clean eating · ORTO-15 · Psychometrics · Eating disorder · Pathological eating

Introduction

Orthorexia nervosa (ON) has been described as a set of behaviours and beliefs characterised by an obsession with “healthy” or “pure” eating [1]. This fixation on the purity of food as opposed to its quantity is the main feature of ON. According to the proposed diagnostic criteria by Dunn and Bratman [2], individuals suffering from ON are preoccupied with either affirmative or restrictive dietary practices believed to promote health. Dietary restrictions escalate over time and may cause the exclusion of entire food groups. Violation of self-imposed rules causes a sense of personal impurity, anxiety, and guilt resulting in compensatory behaviours

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✉ Elina Mitrofanova
elina.mitrofanova@gmail.com

¹ School of Life Sciences, Pharmacy and Chemistry, Kingston University, Penrhyn Road, Kingston upon Thames KT1 2EE, Surrey, UK

² Peter Symonds College, Winchester SO22 6RX, Hampshire, UK

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such as an even stricter diet, exercise, or a “cleanse” (attempt at ridding the body of substances perceived to be toxic or unhealthy, often by limiting food consumption to only water or other liquids). Such behaviours may result in unbalanced and insufficient diets, weight loss, and impairment of social and professional lives. Individuals suffering from ON may have difficulty eating with others who do not share their rigid dietary beliefs, place a high value on maintaining control over food preparation and tend to follow a very strict meal-time schedule [3–5].

Despite the growing interest in ON in academia [2, 6], this condition is not officially recognised in the Diagnostic and Statistical Manual of Mental Disorders [7]. Some researchers suggest that ON is strongly related to obsessive-compulsive disorder (OCD) [8, 9], while others suggest that symptoms of ON overlap with symptoms of Anorexia Nervosa (AN) [10]. Unlike individuals diagnosed with AN, individuals suffering from ON are not secretive about their preferred diet and do not experience body image disturbances that are based on perceived weight or body shape [2]. A neuropsychological study found symptoms of all three conditions (OCD, AN and ON) to be related [8]. However, it is not clear if obsessive thoughts are a source of distress for individuals suffering from ON, or if compulsive behaviours are aimed at preventing a catastrophic event or at reducing distress. Despite lacking official recognition, ON is a sufficiently recognised entity in need of further inquiry [11]. What makes ON an intriguing condition is that various definitions seem to capture part but not the whole essence of the phenomenon. Reflecting on developments since the inception of the term, Bratman [12] emphasises the progression of the condition where the first stage is more of a (commendable) lifestyle choice adhering to a healthy diet (and exercise), even if such diet involves unusual and irrational ideas. It is the second stage of ON that is problematic and involves pathological behaviour.

Detecting orthorexia nervosa

Despite that the condition has not been recognised as a disorder, the literature on orthorexia has been dominated by the studies aimed at establishing its prevalence in a number of different samples [13–17]. The absence of official recognition and established clinical diagnostic criteria of the condition renders prevalence assessment premature. Firstly it is because the presence of a condition cannot be detected without having a clean definition of what is being assessed. Secondly, even if there is a general agreement that the condition exists, the absence of established diagnostic criteria for ON impairs the development of screening tools for the condition, and limits the validity of prevalence assessments.

To date, two questionnaires are commonly used to measure the prevalence of orthorexia: the 10-item Bratman

Scale [4] and the ORTO-15 questionnaire [13]. The academic community has mostly disregarded and criticised the 10-item Bratman Scale for the lack of validity demonstrated in the research, and for the fact that creators of the scale did not follow standardised statistical procedures when creating it [18].

The ORTO-15 questionnaire, which has been the most widely used measure [19], consists of 15 multiple-choice questions, six of which were taken from the Bratman scale. There are several translations of the original Italian version of ORTO-15, including Turkish, Hungarian, English, and Polish. Responses are scored on a 4-point Likert-type scale, which includes: “always” = 1, “often” = 2, “sometimes” = 3, and “never” = 4. Scores above 40 are suggested to indicate the absence of ON. According to the original authors’ instructions, items 2, 5, 8 and 9 are reverse-scored (“always” = 4, “often” = 3, “sometimes” = 2, “never” = 1). Items 1 and 13 are scored as: “always” = 2, “often” = 4, “sometimes” = 3, “never” = 1.

Concerns about ORTO-15 as a screening tool for orthorexia

The results from prevalence studies using ORTO-15 vary from 6% prevalence in an Italian sample to 88.7% in a group of female nutritionists [2]. Interestingly, a recent study with US college students found a prevalence of 71%, although less than 1% experienced impairment in everyday activities and medical problems caused by their diet [20].

Recognising potential problems with ORTO-15, Møller and colleagues conducted confirmatory factor analyses of the 15-, 11- and 9-item versions of the scale and concluded that none of the three versions showed acceptable model fit [21]. With eliminating two items from the shortest scale, the ORTO-7 model was proposed. Items of the different ORTO-scale variants are presented in Table 1.

Although new instruments for detecting orthorexia emerged in Germany, (Düsseldorf Orthorexia Scale [5]), USA (Eating Habits Questionnaire [22]), Spain (Barcelona Orthorexia Scale [23] and Teruel Orthorexia Scale [24]), the ORTO-15 has remained the most widely used scale in the academic literature on ON, thus warranting the need for further investigation to ascertain if items of ORTO-15 fully capture the construct of orthorexia. Yet, and despite the recurrent and well-documented problems with ORTO-15 [25, 26], no attempt has been made to explore the potential reasons for the poor performance.

Aim

This study aimed to investigate the reasons behind the poor performance of ORTO-15 with the view to identifying ways for improvement and to facilitate developing

Table 1 Summary of qualitative elaborations on each of the ORTO-15 items in the context of different English variants

ORTO-15 items	ORTO-11 version (Arusoglu et al. 2008)	ORTO-9 version (Missbach et al. 2015)	ORTO-7 version (Moller et al. 2018)	Qualitative analysis (Problematic items)
1. When eating, do you pay attention to the calories of the food?	–	–		13
2. When you go in a food shop do you feel confused?	–	–	–	15
3. In the last three months, did the thought of food worry you?				17
4. Are your eating choices conditioned by your worry about your health status?				16
5. Is the taste of food more important than the quality when you evaluate food?			–	21
6. Are you willing to spend more money to have healthier food?			–	10
7. Does the thought about food worry you for more than three hours a day?				12
8. Do you allow yourself any eating transgressions?		–	–	7
9. Do you think your mood affects your eating behaviour?	–	–		6
10. Do you think that the conviction to eat only healthy food increases self-esteem?			–	19
11. Do you think that eating healthy food changes your life-style (frequency of eating out, friends, ...)?				13
12. Do you think that consuming healthy food may improve your appearance?			–	7
13. Do you feel guilty when transgressing?		–		12
14. Do you think that on the market there is also unhealthy food?		–	–	9
15. At present, are you alone when having meals?	–		–	4

new screening tools. Initially, our study aimed to explore people's thought processes about the ORTO-15 items. In line with the "think loud" methodology, we set out to understand why certain items are problematic. Putative reasons for this could include items where participants are unsure what the statement is about (e.g., contains two issues in one sentence) or have cognitive conflicts (e.g., honestly should answer affirmatively but for a different reason). This initial phase focussed on the functionality of ORTO-15.

Subsequently, we also analysed the qualitative responses to identify congruencies and potential discrepancies between participants' experience of orthorexic tendencies (where applicable) and the existing understanding of the condition in the literature. This phase was conducted retrospectively via analysing participants' thoughts expressed for each ORTO-15 item, not by directly asking participants to elaborate on their views on orthorexia. With this added analysis, we focused on the introspective reflection about the *behavioural aspects* with the view to investigate which facets of orthorexia, if any, manifest in people's thoughts when responding to items of ORTO-15.

Method

Design

The study used a mixed methods design, incorporating both quantitative and qualitative methods. Participants first provided demographic, self-reported anthropometric and health-related information. Qualitative data consisted of participants' written "think aloud" responses to the ORTO-15, which were analysed via content and thematic analyses.

In the qualitative component of the study, we asked participants to reflect on and verbalise their thoughts when completing the ORTO-15. We employed a method inspired by the "think aloud" protocol [27], which requires participants to verbalise their thoughts while completing a cognitive task. The "think aloud" method has proven to be a valuable way of exploring how and why respondents arrive at their answers, and to identify problems respondents experience when completing a scale. It has been used successfully to examine the content validity of several

questionnaires [28–33]. Successful utilisation of the “think aloud” method may, therefore, offer empirical support for improving psychometric measures. This study’s method deviated from the original “think aloud” protocol in two ways: participants’ thoughts were captured retrospectively not simultaneously; and in written form not verbally. The current procedure involved recording people’s written verbalisations of cognitive processes in response to every item of the ORTO-15. The advantage of conducting retrospective “think aloud” protocol involves a decrease in reactivity whereby performance might be enhanced due to a more structured working process or diminished by a double workload of responding to a question and vocalising the thought process simultaneously. Participants are allowed to provide reflections on the items at their own pace.

Given the lack of understanding of the symptoms of ON, and the potential overlap with other eating disorders and OCD [10], this study has moved beyond single “think aloud” assessment and included additional psychometric measures to identify possible link to other disorders; and most importantly their potential influence on how people answer the ORTO-15 items. Thus the quantitative part included two established psychometric measures designed to identify the presence of OCD symptoms and to assess eating disorder risk. All collected data were collected anonymously, with implied consent. Qualitative responses were entered by the participants directly onto the online survey. Although participants were recruited via personal contacts, there was no way researchers could tell who accepted the invitation and completed the survey because identifiable personal information (including IP addresses) were not recorded.

Collection of the sample

Adults residing in the UK with a minimum age of eighteen years old were invited to participate in this study. No exclusion criteria were applied to ethnic background, occupation or sociodemographic status. Individuals had to be able to speak English fluently as a second language or be native English speakers. Participants were recruited from the research team’s contacts using the snowball sampling and were approached based on the research team’s prior knowledge of existing restrictions in their diet. Several individuals (informants) known to exhibit orthorexic tendencies (i.e., restricted eating behaviour, avoidance of certain foods, particular food beliefs) were approached and asked to participate in this study voluntarily and to help identify individuals known to them that exhibit similar eating patterns. Our purposeful sampling strategy targeted people who were interested in integrating ‘clean eating’ principles into their daily life; interest; and reported at least some signs of orthorexic eating behaviour. These included self-imposed

distinctive and sustained dieting behaviour for health reasons; voluntarily restricted their food based on characteristics of the foodstuff (i.e., omitted certain food groups for no medical reasons; or only consumed specific type of food such as organic, raw, etc.). Because the ORTO-15 is designed to screen population for orthorexia, we included a wide spectrum of ‘healthy eaters’, potentially problematic and non-problematic, to see if responses to the ORTO-15 items differ between those who score beyond the recommended cutoff of 40.

Measures

All questionnaires were hosted on a closed survey platform (SurveyMonkey) accessible via a designated link. Demographic information (age, gender, ethnicity, occupation, and current living situation) was collected. Self-reported anthropometric measures consisted of height, current weight, lowest weight, highest weight, and desired weight. Health-related questions enquired about the presence of diagnosed health conditions that might affect eating behaviour.

2.3.1 ORTO-15

The English version of ORTO-15 included 15 original items with a comment box for each question. Responses were scored in accordance with the original authors’ instructions. According to the authors of scale, scores beyond 40 showed a good predictive capability for the presence of ON [13].

Psychometric measures

The Eating Attitudes Test (EAT-26). The EAT-26 [34] is a widely used 26-item standardised self-report screening tool used for identifying symptoms characteristic of eating disorders. It consists of three subscales: (1) dieting, (2) bulimia and food preoccupation, and (3) oral control. A score higher than 20 suggests the possible presence of disordered eating [34].

The Obsessive–Compulsive Inventory-Revised (OCI-R). The OCI-R [35] is an 18-item self-report measure for assessment of six common OCD symptoms: checking, hoarding, obsessing, ordering, neutralising and washing. Scores above 20 indicate presence of OCD [35].

Procedure

Participants were asked to voluntarily take part in the study by completing the online questionnaire and to set aside one hour to comfortably complete all steps. They were made aware that voluntary completion of all measures implied their consent. As part of the recruitment, participants were briefed verbally, and an information sheet was provided as

an embedded part of the questionnaire. Participants were then asked to complete the English version of ORTO-15. The following instructions were provided at the top of the page:

After reading the question, select one response from the prescribed list (i.e. “always”, “often”, “sometimes”, or “never”) and then explain the selection that you made in the comments box provided. Ensure that you have fully answered a given question before moving on to the next.

Additionally, the following instructions were presented before each item of the scale:

Please explain why you answered the way that you did (try to be specific, give an example if needed). We would also be interested to know the extent to which you believe that the response you selected accurately reflects your thoughts, feelings and/or behaviours relevant to the question. You may also want to highlight any terms in the question that are confusing or ambiguous.

The comment boxes were inserted to capture participants' thought processes for qualitative analysis.

Data analysis

Quantitative statistical analyses were performed using IBM SPSS (Statistical Package for Social Sciences) Version 24.0 and JASP (Version 0.11.1) computer software. Bivariate correlation coefficients (r) between EAT-26, ORTO-15 and OCI-R were calculated using the Spearman formula. Associations between categorical variables (binary status of disordered eating, OCD and ON) were tested using chi-square statistics with Fisher's exact probability. Internal consistency reliability of EAT-26, OCI-R and ORTO-15 scores for this sample are expressed as Cronbach's alpha coefficients and McDonald's omega. Participants' open-ended explanations for their response to the ORTO-15 items and feedback about the clarity of the instrument represent the qualitative data. The first author conducted a content analysis [36] of participants' feedback using the Atlas.ti software to identify any problems participants encountered when responding to the ORTO-15. Taking into account both the think-aloud protocols and the quantitative responses to the ORTO-15 a full coding frame was developed. Codes were based on the discrepancies and difficulties expressed while completing the questionnaire. The coding frame was then applied to all the data. Ten transcripts, chosen using the random number generator, were coded by the second author. The initial between-coder agreement was 85%. The coding frame and the coding were revised after the discussion between the two authors and the agreement increased to 100%. The final version of the coding frame consists of five codes where the fifth code represented “no problems” (indicating there were no problems experienced when responding to an item). The remaining four codes represent problematic responses.

The coding frame with codes' definitions can be found in Table 2.

The first author conducted thematic analysis procedure as defined by Braun and Clarke [37] to identify whether participants' feedback was related to orthorexic symptomatology. After repeated reading, the “think aloud” transcripts were explored using open thematic coding according to the “bottom-up principle”. The coding involved assigning codes to the data based on the semantic and conceptual readings. The next steps involved searching for subthemes by means of revisiting the codes and searching for the meaningful patterns across the data that later were grouped into themes. The emerged themes and subthemes were discussed and agreed upon during meetings between the authors.

Results

Description of the sample

Initially, 66 individuals took part in this research. Eight individuals provided demographic information but did not complete any other measures. Their data were removed from the final analysis. Another eight participants reported having medical or psychological conditions that may have an impact on their eating behaviour (i.e., depression, Irritable bowel syndrome, bulimia, anxiety), and their data were therefore excluded. The final sample consisted of 20 males and 30 females, mean ages of 34 years ($SD = 16.3$) and 35 years ($SD = 13.2$), respectively. The majority were of White British descent (88%), and over half (52%) lived with a partner, with an additional 30% living with parents. The average BMI was 25.3 kg/m^2 ($SD = 6.9$).

Quantitative analysis

Descriptive statistics

The mean score for the ORTO-15 was 37.82 ($SD = 4.19$) with 64% of the sample scoring in the ON range. The OCI-R mean score was 12.14 ($SD = 9.65$), and the EAT-26 mean score was 10.08 ($SD = 8.99$), indicating that generally, the sample had a healthy eating attitude. Seven of the 50 participants (14%) were identified as being potentially at risk for disordered eating. Eight participants (16%) were identified for showing OCD tendencies.

Internal consistency reliabilities

The internal consistency reliability of the scores of ORTO-15 in this study was found to have a Cronbach's alpha score of 0.47, which is considered to be very low. McDonald's omega coefficient was 0.56.

Table 2 Coding frame

Code and definition	Description	Example quotes from participants
1. Questioned the wording of the item	Participants did not understand and criticised specific words in the questions. This issue had appeared 21 times across ten items when participants expressed doubts about how the questions were worded. Most often this issue appeared in response to item 4 of the ORTO-15. Individuals openly admitted to not understanding some of the words used in ORTO-15	P16 in response to item 4: When I feel overweight and unhappy with my body image, this motivated me to eat healthier. It particularly works when I start to see a physical change. The question is a little confusing as some people have a different interpretation of a 'health status' P49 in response to item 8: Transgressing is the wrong word, the implication that my food rules are law is rather extreme. Also, not everybody understands the meaning of transgressing P18 in response to item 8: I find this question ambiguous, it's not a word I associate with eating. I guess it means going beyond the eating limit?... P20 in response to item 7: Don't really understand the question P36 in response to item 2: I don't understand what there is to be confused about! P37 in response to item 14: This question is slightly confusing to understand, but I do think that there is a lot of unhealthy food available, and sometimes this is dressed up as being good for you. However, I am not entirely sure what this question is asking P1 in response to item 5: Hard question...something that tastes good is not necessarily quality, depending on how you measure it." and "all of this is more complicated than can be answered here...." P26 in response to item 2: What do you mean by more money? More than I usually spend? Healthier than what?...
2. Did not understand the meaning	When participants did not understand the meaning of the question, provided statements unrelated to the item, and questioned the sensibleness of the item. This problem came up 79 times across all the items when participants struggled to understand what the question was asking. This issue was especially pronounced across items 2 and 10	P3 in response to item 12: I think that consuming healthy food can improve your appearance if it is eaten in the right portion sizes... P4 in response to item 12: Eating healthy has been proven to clear skin, but again it's like a placebo, although it works, it doesn't happen overnight P43 in response to item 5: Sometimes when I'm cooking my own meal I don't worry about what I'm putting in it, I just do what will make it taste better, but I'll was out buying food that's when I calorie-count P18 chose "never" as a quantitative response to item 3 while the qualitative comment indicates the opposite to be true: "When I am consciously eating healthy I always worry about my food choices. Especially when having a good social life, it includes a lot of bad food and drink choices which makes me worry about food" P41 also chose the quantitative response "never" while the qualitative comment indicated: "I'm always worried about what to eat due to my weight issues"
3. Agreed only to a part of the question	When participants' answers indicate partial agreement or disagreement with the question often based on additional information, conditions, or situations. This issue appeared 46 times across the data. Most often it was observed in item 5. Participants expressed their agreement or disagreement with the question based on additional reasoning suggesting that they applied their own frame of reference influenced by alternatives created by the individuals to answer this question	
4. Qualitative response did not concord with quantitative response to questionnaire item	When there is a difference between the reasoning in participants' comments and their response in the questionnaire. This issue has appeared 35 times across 13 items with the most comments clustering in item 3	
5. No problem	When participants did not encounter any difficulties answering the question	

The Cronbach's alpha value of 0.88 for the OCI-R was calculated from this study's sample which signals a good internal consistency reliability of the scores of scale. McDonald's omega coefficient was 0.89.

The Cronbach's alpha value for the scores of EAT-26 in the present study was 0.86, also indicating good internal consistency reliability. McDonald's omega coefficient was 0.85.

Omega coefficients are interpreted in the same manner as Cronbach's alpha. The difference between the observed alpha and omega coefficients lies in the models that define alpha (essential tau-equivalence) and omega (congeneric). In this study, the discrepancy between alpha and omega coefficients of ORTO-15 may have resulted from the violation of essential tau-equivalence model (the assumption of error score of any pair of items is uncorrelated). If this assumption is violated, the true reliability is underestimated [38].

Associations

Key findings from the correlation analysis were as follows: ORTO-15 score was significantly and negatively correlated with the EAT26 score ($r = -0.66, p < 0.001$) and the OCI-R score ($r = -0.30, p = 0.03$). Furthermore, a statistically significant positive correlation was observed between the EAT26 and OCI-R test scores ($r = 0.33, p = 0.02$). (Note that 'at risk' status is indicated by high scores on EAT-26 and OCI-R but low scores on ORTO-15, which explains the negative correlation).

Qualitative analysis

Content analysis on the functionality of ORTO-15

Content analysis of the "think aloud" responses revealed that participants did not encounter problems while filling in the ORTO-15 for the majority of the time (76%). However, a total of 179 problems were identified. Responses were classified as "no problem" unless there were "think aloud" data to the contrary. The mean number of problems per participant was 3.44 with a range of 0 to 9. The coding frame, the definitions of the problems and the quotes from participants

are presented in Table 2, while Table 3 presents the frequency distribution of the identified problems.

Content analysis revealed the item that participants had the most problems with was item 5 (Is the taste of food more important than the quality when you evaluate food?). Most often participants suggested alternative reasoning that the taste is better if the food is of good quality and overall, the two concepts are inseparable. Item 15 (At present, are you alone when having meals?) was the item that elicited the fewest issues. Participants offered comments in a "yes" or "no" format without further elaboration. Most individuals gave an affirmative answer to item 14 (Do you think on the market there is also unhealthy food?). However, the endorsement of this statement does not always mean a higher likelihood of meeting the criteria for ON.

The scores of the scale demonstrated a very low coefficient of internal consistency reliability ($\alpha = 0.47$) which is to be expected considering the number of problems identified. Participants struggled to comprehend the meaning of the item 2 "When you go in a food shop, do you feel confused?". It was unclear to participants why going to a shop would elicit confusion. Another item that was met with a similar reaction is "Do you allow yourself any eating transgressions?". Many participants did not know what the word "transgressions" meant. Understanding the question is the first step participants take when completing a questionnaire. To avoid variation in question comprehension researchers are advised against the use of ambiguous and unfamiliar words [39].

Thematic analysis on the behavioural aspects in ORTO-15 items

Participants' elaborations went further than just simply identifying potential problems with ORTO-15. Therefore, thematic analysis of the transcripts was conducted to identify whether participants' "think aloud" data are linked to the concept of ON and the proposed diagnostic criteria. Four themes were identified: "preoccupation with physical appearance", "control", "food is fuel", and "alone not isolated". Participants are identified by numbers and their respective scores on ORTO-15 are provided in brackets.

Table 3 Frequencies of codes distribution

Codes	Items														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0	1	2	4	2	1	3	2	0	1	0	0	3	2	0
2	4	12	5	6	6	4	5	3	3	13	4	2	5	5	2
3	6	0	0	3	10	3	2	1	2	4	6	5	2	2	0
4	3	2	10	3	3	2	2	1	1	1	3	0	2	0	2
5	38	35	33	34	29	40	38	43	44	31	37	44	38	41	46

Preoccupation with physical appearance For the majority of participants in this study, striving for a healthier diet was motivated by their desire to manage their weight. Participants mention an improvement in physical appearance as the factor that drove them to start eating healthier. Participants identify this improvement in physical appearances, such as weight loss or clearer skin as a direct cause of adherence to the self-imposed diet. These quotes from the transcripts illustrate the point: P1(38): “I have been trying to lose weight, so I was concerned about eating certain things...I wouldn’t say I was worried, but I was conscious of what I was eating.” P10(37): “The experience I have of this is that my skin looks better and keeping an eye on calorie content means I have more control over my figure and therefore appearance...” For many participants in our study weight loss has come to represent their ability to achieve health and well-being.

Control The second identified theme can be defined in terms of participants’ perceived control over their eating behaviours and exercise routines. Participants reported having a strict routine that involved planning meals and regular exercise. People experienced negative emotions if the self-imposed routine wasn’t followed and tried to compensate for it by an extra workout or a stricter diet the next day. For example, P24(41) reported: “I feel guilt if I am not getting to eat in my usual healthy manner”.

Transgressions did not cause any adverse emotions if they were planned and incorporated into the diet. For example, in response to “Do you allow yourself eating transgressions?” P6(42) provided: “Yes small transgressions which I would call treats!” In response to item 13 (Do you feel guilty when transgressing?) P27(39) replied: “it’s a conscious decision, so it would seem illogical to me to then feel guilty. I would factor that into the decision itself.” In fact, by allowing themselves controlled deviations from their diets, participants reported a higher likelihood of adherence.

P47(39) described the role of these deviations: “For the long term, a small transgression avoids completely going off the rails and binging.” Planning served as a protective factor against worry, guilt, and provided a sense of being in control in social situations when participation involved consumption of alcohol and food thought to be unhealthy.

“Food is fuel” This theme describes the participants’ relationship with food. The comments indicate how discourse about food has moved to a view of food as a source of “fuel” for maximising health or physical performance. For example, P41(34) expressed: “I prefer healthy food as then I know my body has the best fuel.” Participants believed that a healthy diet has a direct impact on psychological well-being and physical health:

“What you put into the engine determines how it runs. Again back to vitality. If you are always down, low energy and no get up and go, then the diet in most cases is the cause. Tiredness is the huge issue for women and men with young families, so high energy and protein is important when you lack sleep. For most health issues if you can detect them early enough, food can make a marked difference.” (P31(34), P21(36): “I believe there is a connection between eating healthily and feeling good about oneself, physically and mentally. I know I’m more likely to engage in healthier activities and exercise when I’m following a healthy eating plan, which in turn increases the sense of well-being.”

Participants linked health as a central organising factor in their practices of food selection. A particular perception of the body as a machine that needs the best quality nutrients to perform at its best has emerged from the transcripts.

It appears individuals in this study were faced with a constant challenge to sort through the food-related information and were preoccupied with the evaluation of risks and benefits of food. Participants demonstrated a high level of confidence in their knowledge of nutrition and defined their relationship to food as a never-ending process of information seeking and self-education potentially with a limited scientific basis. On the other hand, some individuals found this strive for nutritional knowledge very distressing and expressed uncertainty about the nutritional information they encounter on a day-to-day basis. P3(35) has expressed a general mistrust to food-related information offered on the market: “There are so many food items out there now that claim to be healthy or better for you but all with hidden sugars and salt. It can be very confusing to know what is best to eat and best to buy.”

“Alone not isolated” This theme describes various social contexts within which participants described their food choices and practices. Impairment of social life resulted from an excessive focus on healthy eating has been implicated in one of the diagnostic criteria proposed by Dunn and Bratman [2]. This study, however, did not yield support for this assumption. Participants did report being alone during meal times which was not experienced as social isolation but was rather a conscious preference or reflected individuals’ living situations:..P46(37): “I live alone so yes am always on my own when I eat breakfast and dinner, lunch at work.”

P38(35): “Monday to Friday I have lunch at work I bring food from home cooked by me the night before I usually eat with colleagues. Evenings and weekends I eat with my husband.” The importance assigned to following

a healthy diet outweighs the need for social interaction. Furthermore, some individuals perceived social engagements as an obstacle to a healthy lifestyle:

P17(31): "I feel like my social life always gets in the way of eating healthily. If I am eating healthily, I am less likely to go out and have a social life as I become too tempted to eat the wrong foods..."

Even though the data suggest that participants' social lives were affected by their diets, psychological discomfort, proposed by previous research, caused by social isolation was not reported in this study.

Discussion

The main purpose of this study was to explore the nature and extent of problems individuals encounter when they complete the ORTO-15. This study also sought to compare participants' responses to ORTO-15 with three additional questionnaires measuring related phenomenon to further determine the validity of the ORTO-15. As in previous studies employing the "think aloud" technique [28, 31], participants did not encounter any difficulties responding to the scale the majority of the time. The success of the think-aloud technique depends on participants' ability to verbalise their thoughts, and individuals differed in their performance throughout the task. Because the responses were coded as "no problem" unless "think aloud" data indicated otherwise, it is important to acknowledge that the issues with the scale might have been underestimated.

Prevalence of ON by ORTO-15

Consistent with previous studies using the ORTO-15, the putative prevalence of ON symptoms was relatively high (70% of the sample) compared to the prevalence of AN in general population (0.9% among women and 0.3% among men) [40]. Similar findings were previously observed in other countries where researchers used the ORTO-15 to assess the prevalence of ON in various populations [15, 18, 41, 42]. However, reported 'prevalence' data on ON must be interpreted with great caution for multiple reasons.

Firstly, ON has not yet been recognised as a bona fide disorder, thus any assessment of the condition is somewhat arbitrary and based on assumptions and not clinical data about the aetiology and manifestation of ON (e.g., ON is a form of an eating disorder or an obsessive-compulsive disorder). Secondly, no studies using ORTO-15 were set up to estimate population prevalence. Without exception, these studies used convenience sampling not representative for the population [19]. At best, these studies show the number of individuals identified for reporting putative ON symptoms in the sample. Finally and most importantly for our study, the

dominant assessment tool, ORTO-15, has been challenged for its validity and propensity to identify the healthy spectrum of controlled diet as ON which inflates the number of observed ON cases in the sample. Our study adds qualitative evidence to this criticism. It is also notable that those participants in this study who were identified for ON by the ORTO-15 scored just beyond the cut-off point of 40 thus they were borderline for ON. Using a more exclusive cut-off point to fall between 35 and 40 for being more specific in identifying ON tendencies (Table 4, p31 in Donini et al. [13]), these individuals would have classified as non-ON. Such choice of course reduces the chance for incorrect positive classification at the expense of an increase in missing genuine positive cases. Because ON is thought to be on a continuum [43], cut-off points should be interpreted in context, not in absolute terms.

Construct validity and accuracy

This study found a significant negative correlation between the scores of ORTO-15 and both OCI-R and EAT-26. Lower scores on ORTO-15 indicate the presence of ON while higher scores on OCI-R and EAT-26 indicate the presence of OCD and eating pathology. Observed negative associations, therefore, suggest that there are overlaps between ON and symptoms of other eating disorders as well as OCD. The association between ORTO-15 and EAT-26, however, needs to be interpreted with caution since there is similarity between items in these questionnaires.

Functionality of ORTO-15

Problems were identified across all items, and 46 out of 50 participants encountered at least one issue. Four individuals did not elaborate any 'think aloud' data but responded to the scale items. Their contributions were, therefore, coded as 'no problem'. Items that elicited the biggest number of issues were: 5, 10, 3, 4, and 2. In a study by Moller and his research team [21], items 5, 2 and 10 were highlighted as problematic and dropped from the developed ORTO-7 as shown in Table 1. Item 15 elicited the least confusion. However, the wording of this question does not allow for the intended concept of social isolation to be identified as potentially causing distress. Even though the nature and frequency of the problems varied, all items elicited at least one issue.

Orthorexic traits: comparing reflection on the behavioural components of ON with other disorders

Results of the thematic analysis in this study support the hypothesised overlap of obsessive-compulsive and eating disorder traits in ON. The identified "control" theme is a

factor underlying participants' adherence to self-imposed diets. Previous studies have recognised the importance of personal control in eating disorder symptoms and OCD [44]. For example, people suffering from OCD often perform strict monitoring of their thoughts and actions and impose rules to dictate their behaviour. Behaviours such as checking, hoarding and performing rituals may be understood as attempts at establishing control. What the participants in the current study described are very similar to the attempts at establishing control over one's environment experienced by individuals suffering from OCD. Control has also been studied for its connection to AN [45]. Fairburn and colleagues, for example, proposed that within the AN framework being successful at controlling one's body shape and weight is an indicator of self-worth and overall self-control [46]. Also, many individuals report beginning to diet at a time of their lives they perceived to be chaotic and beyond their control [47]. Results of this study suggest that control, despite being one of the symptoms implicated in AN and OCD, might be one of the main features of ON.

Despite literature suggesting that ON's most pronounced difference from other eating disorders is the motivation for following a diet of choice, our data revealed that the desire to lose weight was a significant factor. In past research, weight loss as a behavioural motivator was linked with the symptoms of AN [48], while the lack of desire to lose weight is one of the most critical factors separating ON from other eating disorders [2]. Similar to this finding, a recent study investigating a possible link between ON, perfectionism, body image, and attachment style has identified that fear of becoming overweight and a greater focus on appearance to be associated with lower scores on the ORTO-15 [49]. Physical appearance as a main motivating factor for following a "clean" diet could have a bigger role in ON than previously suggested.

Another identified theme sheds light on participants' social lives: the data suggest individuals did not place any importance on the social rituals surrounding food consumption. It may be that this phenomenon is experienced by society as a whole and does not indicate the presence of ON. Nicolosi [50] proposed that orthorexia as a concept can be extended beyond individual pathology to describe a social phenomenon. Nicolosi argues that individuals in modern society are constantly reminded of the importance of diet on their physical health while at the same time the distance between them and food production grows. People have less and less knowledge about how food is managed, processed, and sometimes prepared while the discourse about healthy eating in popular media intensifies. This lack of knowledge about food production and intense discussion about risks and benefits of a healthy diet is at the core of rising dietary anxiety and food risk perceptions [51]. In today's society, family meals are often sacrificed for work responsibilities. For the participants, social isolation was

not a cause for distress but rather a general aspect of changing social habits. It is possible that this phenomenon is a societal norm and not indicative of ON and therefore not valid in terms of diagnosis. Themes identified in this study suggest that ON might have more in common with AN and OCD than was previously suggested. In addition, some concepts (e.g. social isolation and a lack of consideration for one's weight) did not seem relevant to the experiences of participants in this study.

Limitations

Our study has its limitations, among which are those of the "think aloud" method. The "think aloud" protocol states that participants are meant to verbalise their thoughts while completing a scale, in this study the data were collected online which limits researchers' supervision over the process. For future research, it would be beneficial to conduct in-depth interviews to explore people's experience of ON and contribute to the creation of a reliable diagnostic tool. Another improvement would be to carry out a nutritional assessment of participants' diets. Research in the field of ON is still scarce, and to date, there are no universally accepted diagnostic criteria. Without a proper dietary assessment, it is impossible to ascertain if the orthorexic diet does lead to malnourishment as some of the proposed diagnostic criteria claim. Future research should focus on developing a new diagnostic tool as well as investigate the nutritional composition of the orthorexic diet.

Another possible limitation to this research is the modified procedure of the "think aloud" protocol. Concurrent variation of the protocol might have provided a richer account of the potential issues with the scale. Non-verbal information (pauses, utterances, body language) that concurrent "think aloud" procedure provides could contribute to further understanding of the difficulties people experienced when responding to ORTO-15.

The second part of our study, which led to the thematic analysis of the qualitative responses from our participants, presents a post hoc analysis of the existing data. As such, results from this only offer limited insight into people's thoughts on their choices about diet and eating habits, and not on ON. We conducted and included this secondary analysis because we felt that the qualitative data add value to this study and can inform future research on and screening measures for ON. The richness of these data is also limited by modified 'think loud' procedure.

Conclusion

In conclusion, this study attempted to identify problems people experience completing the ORTO-15. We have conducted a "think aloud" protocol to address the issues with

the scale. Thematic analysis of the data has brought forward aspects of ON previously overlooked in the research. The instrument's validity was under scrutiny by earlier research, and our results highlight a number of problems with the ORTO-15. The ORTO-15 is not an adequate scale to detect orthorexic behaviours and attitudes. Taking the qualitative and quantitative results together, it appears that at best, ORTO-15 taps into diet habits and lifestyle (stage one) but fails to detect the pathological aspect (stage two). To date, several questionnaires have been developed. However, attempting to identify prevalence rates of a condition that is yet to be defined is at best premature. More effort should be directed at determining ON as a valid construct.

What is already known on this subject?

ON has been recognised as a potentially pathological condition. There is a lack of agreement on the diagnostic criteria and tools. The commonly used tool to identify ON, ORTO-15, has been suggested to be problematic due to its poor validity and reliability. The reasons for the poor performance of ORTO-15 are yet to be specified.

What does this study add?

This study scrutinised each item of ORTO-15 for functionality (clear statement and instructions; absence/presence of disambiguity, etc.) and content (putative behavioural indicator of ON). Problems were detected across all items. The problem with ORTO-15 lies in its accuracy: it is sensitive to identifying a peculiar dieting habit but lacks specificity (no differentiation between peculiar but normal eating vs. pathological condition).

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Author contributions LM designed the study and collected the data. EM carried out analysis, interpretation of data and drafted the manuscript. EP supervised the qualitative analysis and the development of the manuscript draft. AP supervised the quantitative analysis of data and the development of the final draft of the manuscript.

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Compliance with ethical standards

Conflict of interest The authors have no conflict of interest to declare.

Ethical approval Favourable ethical opinion was granted by the Faculty Research Ethics Committee, Faculty of Science, Engineering and Computing, Kingston University.

Informed consent Informed consent was obtained from all participants prior to commencing the survey. Completion of the survey pack implied consent.

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Appendix 2



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RESEARCH PAPER

Assessing psychological and nutritional impact of suspected orthorexia nervosa: a cross-sectional pilot study

E. Mitrofanova H. Mulrooney & A. Petróczi

Kingston University, Kingston upon Thames, UK

Keywords

dietary intake, orthorexia nervosa, pilot study, psychological traits.

Correspondence

E. Mitrofanova, School of Life Sciences, Pharmacy and Chemistry, Kingston University, Penrhyn Road, Kingston upon Thames, Surrey, KT1 2EE, UK.

E-mail: elina.mitrofanova@gmail.com

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Abstract

Background: To date, research on the dietary patterns of individuals with potential orthorexic symptoms is lacking. This cross-sectional pilot study aimed to explore the feasibility of assessing dietary patterns with psychological traits and states of individuals with possible orthorexic tendencies.

Methods: Dietary intakes of 10 individuals (two males and eight females) were assessed using 24-h recalls. Mean age of participants was 28.3 years; mean body mass index was 21.2 kg m⁻². Nutrient intakes were compared with current dietary guidelines and the Eatwell Guide (Public Health England, 2016). Participants completed the ORTO-15, the Eating Attitude Test (EAT-26), the Obsessive-Compulsive Inventory-Revised edition (OCI-R), Paulhus's Spheres of Control (SoC), the Rosenberg's Self-Esteem Scale (RSES) and the Multidimensional Body-Self Relations Questionnaire (MBSRQ).

Results: High levels of disparity across participants' psychometric scores and 24-h recall results were observed. There was no single pattern of self-imposed dietary restrictions among participants. Described dietary practices failed to meet the guidelines for several nutrients.

Conclusions: The results of this pilot study suggest that an extensive investigation of the diets of individuals with possible orthorexic tendencies in a large-scale study would contribute to the understanding of this condition. In addition, the use of multiple psychometric instruments is recommended for diagnosing orthorexic nervosa.

Introduction

Orthorexia nervosa (ON), referring to a pathological obsession with clean or healthy nutrition, was coined by Bratman in 1997⁽¹⁾. According to proposed diagnostic criteria^(2,4), those with possible ON display restrictive dietary practices aimed at maximising health, which escalate over time potentially leading to social isolation and malnutrition. Transgression of self-imposed rules on food intake results in guilt, anxiety and subsequent compensatory behaviours such as stricter restrictions or 'cleanses'. Engaging in compensatory behaviours, individuals attempt to rid themselves of the substances perceived as impure.

Although there is growing attention to ON in the academic and popular media⁽³⁾, there is no current

consensus on whether the disorder exists, and diagnostic criteria have not been established⁽⁴⁾. ON is not listed in the *Diagnostic and Statistical Manual of Mental Disorders* (5th edn)⁽⁵⁾. However, much research has been conducted subsequently.

The majority of existing research on ON has focused on identifying prevalence in different populations^(6–9), adapting the diagnostic questionnaire in different countries^(10–12), examining potential links to other eating disorders^(13,14), and identifying whether ON may be a variant of obsessive-compulsive disorder (OCD)⁽¹⁵⁾. Studies have identified similarities between ON, OCD and disordered eating^(8,16–19). Dieting, among a range of psychosocial factors such as perfectionism, poor body image and drive for thinness, was also found to be positively associated with ON⁽²⁰⁾. The recent thinking on

ON suggests that, despite existing evidence of social impairments and changes in emotional, cognitive and behavioural functioning, labelling ON as a distinct mental illness should be carried out with caution because it is challenging to distinguish between the conscious control of dietary intake and pathological behaviour when both are aimed at achieving a healthier diet ⁽²¹⁾.

Diets of patients suffering from recognised eating disorders such as Anorexia Nervosa (AN) have received considerable academic attention ^(22–24), and the importance of including nutritional interventions in treatment programs is recognised ⁽²⁵⁾. By contrast, studies of ON have focused on psychological aspects of eating behaviours and reported on the eating behaviours of various groups following specific diets. The majority of such studies have explored whether vegetarian or vegan individuals were at increased risk of developing orthorexic tendencies ⁽²⁶⁾. Although they have used the same scale to measure ON ⁽²⁷⁾, the findings have been inconsistent. Those who followed vegetarian/vegan diets demonstrated greater orthorexic tendencies than those who did not in a sample of Italian students ⁽²⁸⁾, whereas the opposite was shown among American students ⁽²⁹⁾. Other studies did not find higher rates of ON in vegetarians/vegans compared to omnivores and those following paleo diets ⁽¹⁹⁾. However, such studies only assessed dietary intake by asking whether participants adhered to vegetarianism/veganism using a questionnaire.

One study to date that we are aware of has measured the nutritional composition of orthorexic diets in a sample of Greek dietetic students ⁽³⁰⁾. Data were gathered via an online 3-day food diary. Students identified as having ON consumed less energy and saturated fatty acids than non-orthorexic students. These results should be cautiously interpreted because Bratman's Orthorexia Scale (BOT) ⁽³¹⁾ was used to identify ON. Whilst BOT was the first measure developed by Bratman based on ON characteristics observed in patients, it is not a recognised clinical diagnostic tool.

People identified with ON are known to exclude foods perceived as lacking purity or considered harmful to health ⁽⁴⁾. Research to date has not focused on understanding which food groups are excluded from the diet, nor the reasons for their exclusion, and so the implications of dietary restrictions in ON are unclear. Examining the dietary intake of individuals with possible ON could enhance our understanding and shed light on the eating patterns of this population.

The present pilot study is part of a larger study, which focuses on possible overlaps between ON and other conditions, and the dietary intake of individuals displaying orthorexic tendencies. This pilot study explored the feasibility and utility of simultaneously exploring dietary

practices and psychological traits and states of individuals with possible orthorexic tendencies. Alongside the qualitative interviews, participants completed a psychometric assessment and reported their dietary intakes, which formed the basis for this study. It aimed to explore whether there were possible commonalities in restrictive dietary practices between individuals in the context of their lives, as well as to investigate possible implications of dietary restrictions by comparing their intakes with recommendations.

Materials and methods

This exploratory pilot study used mixed-methods as detailed below. Ethical approval was granted for this project by the Kingston University Research Ethics Committee.

Participants

Only participants aged at least 18 years were eligible. No exclusion criteria were applied by ethnic background, occupation or socio-demographic status. Participants were known to the research team from personal and professional contacts (six individuals employed in the fashion industry, one student on nutrition and sports science degree, one participant employed as a psychology researcher and one person recommended by the participants based on their similar eating restrictions). They exhibited dietary restrictions reflective of possible ON symptoms as defined by Dunn and Bratman ⁽²⁾ (e.g. beliefs that some foods compromise 'purity' of their body, obsessive preoccupation with consuming only 'healthy' foods, sense of self-worth reliant on compliance with the diet of choice).

Procedures

Participants were recruited using purposeful snowball sampling techniques. Ten individuals were approached and all agreed to participate in the study. An information sheet was provided to all participants at the recruitment stage and the language used was neutral; ON was not mentioned (see Supporting information, Appendix S1). Recruitment and data collection took place from June to September of 2018.

Data collection

A three pronged approach was employed for data collection. Data collection sessions consisted of (i) semi-structured audio-recorded interviews to collect qualitative data and to ask about psychological conditions including eating disorders; (ii) 24-h recalls to assess dietary intakes;

and (iii) psychometric measures. Eight sessions were held face-to-face, whereas two sessions were conducted via Skype (<https://www.skype.com/en>) because participants were abroad at the time. Skype sessions followed the same format as in-person data collection sessions. The whole data collection process took approximately 2 h per participant. The data analysis of the driving forces behind 'qualitative attribute based' food restriction practices of participants will be published separately. Qualitative data were used only for context in the present study, which focuses on 24-h recall data and psychometric assessments.

Measures

Participants self-reported their heights and weights from which body mass index (BMI) was calculated⁽³²⁾.

Dietary intake

During the interview, participants were asked to report whether they followed any specific diets (e.g. vegetarianism) and the extent of day-to-day dietary variation. All participants indicated that they rigidly followed the same patterns every day. Consequently, nutritional intake was assessed via in-person 24-h dietary recall interviews. Participants were asked to recall all the foods and drinks consumed in the previous 24 h, followed by checking questions to clarify food preparation methods and detail about additional ingredients in foods and beverages (e.g. milk and sugar in drinks, herbs and spices in meals). Participants indicated the portion sizes of the foods/drinks consumed using photographs of different portion sizes⁽³³⁾. Data were entered into DIETPLAN 7 (Forestfield Software Ltd, Horsham, UK), which generated individual reports of macro and micronutrient intakes.

Psychometric measures

A questionnaire was compiled of a battery of psychometric assessments based on previous research^(15,17,34,35). Eight participants completed this on paper after the nutrition interview, whereas two were provided with an online link using SurveyMonkey.com after their interviews via Skype.

Assessment of orthorexic tendencies

For identifying the possible presence of ON, participants completed the English version of the ORTO-15⁽²⁷⁾ questionnaire. However, participant selection did not rely on completion of ORTO-15; in the present study, it was used to identify possible orthorexic tendencies in participants, not as a diagnostic tool. At the time of ethics application and data collection, it was the only questionnaire widely available. Despite limitations, it is used in the majority of studies to identify those with ON⁽³⁶⁾. It consists of 15

items with responses based on a four-point Likert rating scale. Scores below 40 indicate orthorexic tendencies⁽²⁷⁾.

Assessment of potential problematic eating patterns

Participants completed the Eating Attitude Test (EAT-26)⁽³⁷⁾, a standardised psychometric measure to identify symptoms characteristic of eating disorders. It comprises 26 items forming three subscales: dieting, bulimia and food preoccupation, and oral control. A score above 20 suggests a possible risk of eating disorder.

Obsessive-compulsive tendencies

Potential overlaps between ON and OCD were assessed using the Obsessive-Compulsive Inventory-Revised (OCI-R)⁽³⁸⁾. This consists of 18 statements assessing six common OCD symptoms, each scored on a five-point Likert rating scale. A score at or above 21 indicates the presence of OCD⁽³⁸⁾.

Control

Perceived locus of control was assessed with the personal control subscale of the Paulhus Spheres of Control scale⁽³⁹⁾. This subscale consists of 10 statements with seven-point Likert-type ratings measuring beliefs about levels of control people have over their lives. Scores below the normal range (<43.1) indicate feeling less in control than the average person, whereas scores above the normal range (>59.7) signal feeling more in control than average.

Self-esteem

The Rosenberg Self-Esteem Scale (RSES)⁽⁴⁰⁾ consists of 10 items with four-point Likert-type rating. Scores <15 indicate low self-esteem.

Body image

Body image perceptions were examined using the Multidimensional Body-Self Relations Questionnaire (MBSRQ)⁽⁴¹⁾. This 69-item questionnaire contains nine subscales: appearance evaluation, appearance orientation, fitness evaluation, fitness orientation, health evaluation, health orientation, body areas satisfaction, overweight preoccupation and self-classified weight. There are no cut off scores (author-provided population averages for each subscale used).

Statistical analysis

Individual macro- and micronutrient intakes generated by DIETPLAN 7 were compared with national age and gender-specific recommendations⁽⁴²⁻⁴⁵⁾ and to the Eatwell Guide⁽⁴⁶⁾. All scores were treated individually; inferential statistics were not used as a result of the small sample size in this pilot study.

Results

Eight females and two males participated, with mean (SD) ages of 28.4 (4.37) years and 28 (5.66) years, respectively. All participants were part-time or full-time employees. No participant reported a history of or current psychological conditions or eating disorders. Anthropometric data of the 10 participants are shown in Table 1. Four individuals had a BMI below the healthy range (18.5–24.9 kg m⁻²) and one had a BMI of 27.2 kg m⁻² in the overweight range.

Scores for psychometric measures are shown in Table 2. The internal consistency reliability of the scores of ORTO-15 in the present study was found to have a low Cronbach's alpha score of 0.50. McDonald's omega coefficient was 0.62. However, these coefficients should be interpreted with caution because of the small sample size. Eight of 10 individuals scored within the orthorexic range (scores <40; <35). The scores of the remaining two were just above the cut-off point. Results for other psychometric tests were more diverse. Only one participant exhibited eating patterns that suggested disordered eating as identified by EAT-26. Similarly, only one individual had a score indicating the presence of obsessive-compulsive symptoms.

All participants reported normal to high levels of perceived self-esteem on the RSE scale (i.e. scores of 15–30). Only one had a score indicating feeling less in control than average, according to the Paulhus's SoC scale.

Four individuals reported adhering to veganism, one to vegetarianism and one followed a halal diet. The remaining four individuals did not adhere to any specific diets. However, the four vegan participants had anomalous descriptions of veganism; three reported regularly consuming foods normally excluded by vegans (e.g. eggs, chicken). All participants indicated high levels of rigidity in their daily diets with little individual day-to-day

variation. However, none of the participants reported feeling distressed as a result of adherence to their diets.

Table 3 presents specific nutrient intakes of participants compared with current dietary guidelines^(42–45). Reported diets of nine out of 10 participants indicated inadequate energy and calcium intakes. Eight of 10 individuals reported low intakes of fat and iron, whereas intakes of saturated fatty acids exceeded recommendations for five individuals.

Participants' dietary intakes were also compared with the Eatwell Guide to identify whether there were commonalities in restriction of particular food groups⁽⁴⁶⁾. No single pattern of deviation from the recommendations was found, apart from the majority of participants reporting very low intakes in the 'dairy and alternatives' category (Table 4).

Discussion

The present study aimed to pilot the feasibility and utility of simultaneously exploring dietary practices and psychological traits and states of individuals with possible orthorexic tendencies. Of particular interest was whether individuals exhibiting ON would present a dietary pattern specific to this elusive condition.

Of note was the high level of disparity across participants' psychometric scores, 24-h recalls and self-reported dietary preferences. We chose three participants to demonstrate the extent of disparity identified within the study population. Em was chosen because of a score in the OCD range as identified by the OCI-R; Ebou was chosen because of a high score on the SoC scale; and Rafaela was selected as a result of scoring in the eating pathology range on the EAT-26. All are referred to by their chosen pseudonyms.

Previous research suggests a possible link between ON and OCD⁽¹⁵⁾. In the present study, only one participant

Table 1 Anthropometric measures and self-reported dietary preferences of participants (n = 10)

Participant ID*	Sex	Age (years)	Height (m)	Weight (kg)	BMI (kg m ⁻²)	Self-reported dietary preferences.
Ebou	Male	32	1.89	88	24.6	Halal
Matt	Male	24	1.83	91.7	27.2	None
Anna	Female	25	1.79	58	18.1	Vegan
Em	Female	35	1.60	54.9	21.4	Vegan
Sarah	Female	29	1.73	51	17	Vegetarian
Lynn	Female	24	1.78	54	17	Vegan with occasional addition of chicken.
Silvia	Female	23	1.68	49	17.4	Vegan with occasional consumption of eggs
Elizabeth	Female	33	1.71	57	19.5	None
Rafaela	Female	27	1.65	57	20.9	None
Cat	Female	31	1.76	57	19	None

*Pseudonyms are used throughout.

BMI, body mass index.

Table 2 Individual results from the psychometric measures

Participant ID	ORTO-15	EAT26	RSES	R	OCI-AE	SoC	MBSRQ-AE	MBSRQ-FE	MBSRQ-HE	MBSRQ-AO	MBSRQ-FO	MBSRQ-HO	MBSRQ-IO	MBSRQ-OWP	MBSRQ-SCW	MBSRQ-BASS
Ebou	27	17	27	20	70	5	4.80	5	4.25	3.83	4.86	1.20	1	3	5	
Matt	41	19	23	11	56	3.71	2.60	4	3.33	3.67	3.43	3.40	2.50	3	3.50	3.11
Anna	35	2	30	6	63	4.71	4.60	3.67	3.67	3.92	4.29	3.60	3	3	3	4.56
Em	33	1	28	21	56	3.57	3.20	3.33	2.58	2.98	4.00	3.40	1.75	3	3	3.44
Sarah	41	14	15	17	52	3.14	3.80	3.50	3.58	3.58	4.14	3.80	3	3	3.50	2.78
Lynn	35	6	24	17	49	4.57	3.80	3.17	3.92	3.67	4.29	4.20	1.25	2.50	2.50	4.22
Silvia	34	10	21	15	40	3.29	3.20	4.33	4.42	3.33	4.00	2.80	2.50	3	2.89	
Elizabeth	35	4	21	10	46	3.43	3.20	3.33	3.25	3.25	4.00	3.60	2.25	3	2.78	
Rafaela	29	22	20	13	57	3.86	2.60	4	4.33	2.83	3.43	3.40	3.50	3.50	3.44	
Car	31	4	27	14	54	4.14	5	4.17	4.25	4	3.29	2.60	1	2.5	2.5	4.56

ORTO-15⁽³⁷⁾, Cut-off scores of 40 and 35 were employed. Scores < 40; < 35 indicate presence of ON. EAT-26: Eating Attitudes Test⁽³⁸⁾. Scores above 20 indicate the presence of disordered eating attitudes. RSES: Rosenberg Self-Esteem Scale⁽³⁹⁾. The scale ranges from 0 to 30. Scores between 15 and 25 are within normal range; scores below 15 suggest low self-esteem. OCI-R: Obsessive-Compulsive Inventory-Revised⁽⁴⁰⁾. Cut-off score is 21, with scores at or above this level indicating the likely presence of OCD. SoC: Paulhus Spheres of Control Scale⁽⁴⁰⁾. Scores below the normal range (<43.1) indicate feeling in less control than the average person; scores above the normal range (>59.7) indicate feeling in more control than the average person. MBSRQ: Multidimensional Body-Self Relations Questionnaire⁽⁴¹⁾. MBSRQ-AE: Multidimensional Body-Self Relations Questionnaire Appearance Evaluation subscale assesses feelings about physical appearance; higher scores indicate greater satisfaction with appearance; MBSRQ-FE: Multidimensional Body-Self Relations Questionnaire Fitness Evaluation subscale assesses feelings of being physically fit; high scores indicate person's belief of being 'in shape'; MBSRQ-HE: Multidimensional Body-Self Relations Questionnaire Health Evaluation subscale assesses feelings of physical health; high scores indicate belief that one's body is in good health and is free from illness; MBSRQ-HO: Multidimensional Body-Self Relations Questionnaire Appearance Orientation assesses investment in appearance; higher scores indicate more importance and attention placed on looks and more engagement in grooming activities; MBSRQ-IO: Multidimensional Body-Self Relations Questionnaire Investment Orientation subscale assesses the extent of investment in fitness level or athletic competence; high scores value fitness and are actively involved in activities to enhance or maintain their fitness; MBSRQ-HO: Multidimensional Body-Self Relations Questionnaire Health Orientation assesses the extent of investment in healthy lifestyle; high scores are health conscious and try to lead healthy lifestyle; MBSRQ-Q: Multidimensional Body-Self Relations Questionnaire Illness Orientation assesses the extent of reactivity to being or becoming ill; MBSRQ-Q: Multidimensional Body-Self Relations Questionnaire Overweight Preoccupation assesses one's fat anxiety, weight vigilance, dieting, and eating restraint; MBSRQ-SCW: Multidimensional Body-Self Relations Questionnaire Satisfaction with discrete aspects of one's appearance, high composite scores are generally satisfied with most areas of their body. Values in bold indicate problem scores for individual tests.

Table 3 24-h recall assessments compared with the reference nutrient intakes and estimated average requirements

Participant	Energy intake (kcal)	Protein (g)	Carbohydrate (g)	Fat (g)	Trans fats (g)	SFA (g)	MUFA (g)	PUFA (g)	Fibre (g)	Iron (mg)	Calcium (mg)	Vitamin B12 (µg)	Folate (µg)	Vitamin C (mg)	Vitamin A (µg)	Zinc (mg)
Ebou	1125	79.3	143.6	29.8	0.54	7	13	4.2	9.8	3.57	148	3.3	101	63	138.8	5.56
		27.7%	47.1%	23.5%	0.43%	5.6%	10.4%	3.36%								
Matt	2142	157.7	166.5	98.3	2.02	24.9	39.2	22.2	35.2	17.38	532	7.8	497	684	1696.7	18.27
		28.5%	28.2%	40%	0.85%	10.46%	16.47%	9.33%								
Anna	1721	50.1	204.8	83.7	0.10	24.2	35.8	19.7	19.5	10.11	565	1.4	207	73	204.8	7.23
		11.4%	43.6%	42.8%	0.05%	12.66%	18.72%	10.30%								
Em	1330	37.8	252.3	26.1	0.01	3.7	12.5	6.5	37	10.90	391	-	201	477	973.2	4.14
		10.8%	67.3%	16.7%	0.007%	2.5%	8.46%	4.4%								
Sarah	2118	74	292.8	80.8	0.39	17.4	38.7	16.2	25.3	9.92	970	5.4	313	177	163.3	6.47
		13.6%	50.6%	33.5%	0.17%	7.39%	16.44%	6.88%								
Lynn	2183	51.9	349.7	74	0.07	21.4	29.6	9.5	23.7	8.85	245	-	183	167	423	8.73
		9.3%	58.8%	29.8%	0.03%	8.82%	12.2%	3.92%								
Silvia	839	20.9	170.5	19.1	0.01	10.4	5.6	1.6	22	6.28	259	-	260	154	1516.8	3.29
		8.9%	68.1%	18.3%	0.01%	11.16%	6.01%	1.72%								
Elizabeth	2035	79.3	250.9	81.3	0.01	20.1	29.2	14.5	43.4	18.41	634	0.2	359	134	2335.2	13.14
		34.4%	44.3%	14.9%	0.004%	8.89%	12.91%	6.41%								
Rafaela	1424	65.5	174.4	47	0.85	20.2	17.5	4.7	13.2	8.41	540	3.2	134	9	253.7	9.90
		1.8%	45%	29%	0.54%	12.77%	11.06%	2.97%								
Cat	842	36.4	119.4	27.5	1.28	15.4	7.5	1.8	8.4	3.04	479	1.9	55	9	279.5	4.62
		17%	52.2%	28.8%	1.37%	16.46%	8.02%	1.92%								
RNI men	2772*	55.5	50*	35% [‡]	<5 g day ⁻¹	<10% [‡]	12% [‡]	6% [‡]	30 [‡]	8.7 [‡]	700 [‡]	1.5 [‡]	200 [‡]	40 [‡]	700 [‡]	9.5 [‡]
	2749 [†]	15%		2% [‡]												
RNI women	2175 [‡]	45	50% [‡]	35% [‡]	<5 g day ⁻¹	<10% [‡]	12% [‡]	6% [‡]	30 [‡]	14.8 [‡]	700 [‡]	1.5 [‡]	200 [‡]	40 [‡]	600 [‡]	7.0 [‡]
		15%		2% [‡]												

RNI, reference nutrient intakes; SFA, saturated fatty acids; MUFA, mono-unsaturated fatty acids; PUFA, poly-unsaturated fatty acids.

Highlighted values are below the RNI. Italic values are above the RNI.

*Estimated average requirement (EAR) values for men aged from 19 to 24 years old ⁽⁴⁹⁾.†EAR values for men aged from 25 to 34 years old ⁽⁴⁹⁾.‡EAR values for women aged from 19 to 34 years old ⁽⁴⁹⁾.§Dietary reference values for fat and nutrients ⁽⁴⁹⁾.**Dietary reference value for saturated fats ⁽⁴⁹⁾.

Table 4 24-h recall assessments compared to the 'Eatwell Guide' recommendations

	Fruits & vegetables	Beans, pulses, fish, eggs, meat and other proteins ≤70 g day ⁻¹ of red and processed meat. * 40 g day ⁻¹ of which 20 g is oily fish. [†]	Potatoes, bread, rice, pasta and other starchy carbohydrates	Dairy & alternatives	Hydration
'Eatwell Guide'	≥5 portions a day 80 g = 1 portion 150 mL of juice = 1 portion*		≥50% of food energy*	173 g day ^{-1†}	6–8 glasses per day*
Ebou	2.16 portions = 173 g	205.2 g	47.1%	20 g	5 glasses
Matt	10 portions = 800 g	346.8 g	28.2%	0	12 glasses
Anna	6.03 portions = 482 g	106 g	43.6%	34.5 g	8.4 glasses
Em	19.9 portions = 1591 g	20 g	67.3%	20 g	3.16 glasses
Sarah	9.2 portions = 615 g + 220 mL of juice	221.8 g	50.6%	165 g	3.96 glasses
Lynn	7.18 portions = 574 g	66 g	58.8%	20 g	3.36 glasses
Silvia	6.76 portions = 485 g + 46.2 mL of juice	159 g	68.1%	0	1.6 glasses
Elizabeth	13.8 portions = 1032 g + 120 mL of juice	216 g	44.3%	0	5.2 glasses
Rafaela	1.38 portions = 110 g	165 g (processed meat)	45%	20 g	8.8 glasses
Cat	1.25 portions = 100 g	50 g (processed meat)	52.2%	75 g	1.6 glasses

* 'Eatwell Guide' recommendations ⁽⁴⁶⁾.[†] 'Eatwell guide' recommendations according to Scarborough *et al.* ⁽⁴⁷⁾.

(Em) scored within both orthorexic and OCD ranges. Em is a 35-year-old female who identified her diet as vegan, which she said she follows to maximise her health and physical appearance, as well as for ethical reasons. Obsessive preoccupation with food and strict adherence to food consumption rituals have been proposed as defining characteristics of ON in studies attempting to identify its diagnostic criteria ^(2,48,49). However, the role of obsessive-compulsive behaviours as defining features of ON is not yet established. Several studies suggest that people who display obsessive-compulsive features have a greater risk of ON, although these tendencies were not limited to food-related behaviours ^(18,31). Perhaps typical obsessive-compulsive behaviours (e.g. washing or contamination compulsions, excessive checking) are more likely to surface in relation to eating behaviours too. No studies, to our knowledge, suggest a link between veganism and OCD. Her intense interest in food (she describes herself as very particular about the foods she eats) therefore appears to reflect Em's possible orthorexic tendencies, which she expresses through her veganism. Orthorexic tendencies may lead to adverse consequences for an individual; however, caution should be exercised when assigning a label of pathology to orthorexic tendencies ⁽²¹⁾. The use of ORTO-15 in the present study limits our ability to interpret Em's possible orthorexic tendencies as pathological.

Ebou is a 32-year-old male who reported following a halal diet for religious reasons. He also reported consuming only organic fruits and vegetables and avoiding processed foods plus products containing additives or exposed to pesticides. Ebou scored within the orthorexic range on ORTO-15 and obtained the highest score possible on the SoC questionnaire, indicating exceptionally high levels of personal control. Control has been highlighted as central in previous research on AN ⁽⁵⁰⁾. Individuals suffering from AN constantly strive for control over their dietary intakes, activity levels and body weights ⁽⁵¹⁾. Control over body weight may be used by those with AN as an index of their overall self-control and self-worth ⁽⁵²⁾. Although accounts of the role of perceived self-control in eating disorders differ, the common underlying feature is that individuals control their eating behaviours as a coping strategy when there is a lack of perceived control in other aspects of daily life ⁽⁵²⁾. Ebou did not score within the OCD or eating disorder pathology ranges, although high scores on SoC scale are related to both. A recent review on ON ⁽²⁰⁾ suggested that control over eating behaviour is important for individuals displaying ON symptoms and those suffering from AN, although the difference lies in their motivations. Although those with ON symptoms control their intake based on the perceived quality of foods, those diagnosed with AN control the quantity of foods consumed. There are also

differences in the ideal body images of the two groups. Individuals with orthorexic tendencies seek 'pure' bodies⁽⁵³⁾, whereas the ideal body shape and weight for those with AN is significantly underweight⁽⁵⁴⁾. Nonetheless, there may be closer relationships between some aspects of ON and body weight than previously assumed. One recent distinction is that between 'healthy' orthorexia and ON⁽⁵⁵⁾. There is nothing intrinsically wrong with the desire to eat a healthier diet; indeed, it is encouraged. Researchers, therefore, proposed that ON can be viewed as a two-dimensional construct: healthy/protective and pathological⁽⁵⁶⁾, with different motives for food choices between individuals who score in the ON range and those identified as having 'healthy' orthorexic tendencies⁽⁵⁶⁾. Weight control was the strongest motivator among the ON group, whereas the healthiness of food motivated the healthy orthorexia group. In the present pilot study, participants did not identify weight loss as a motivator for their chosen dietary practices.

Only one participant had scores simultaneously indicative of possible ON and of pathological eating patterns using EAT-26. Rafaela is a 27-year-old female who reported no religious or ethics-based dietary restrictions and only buys groceries using an organic food delivery service. Earlier studies linked pathological eating attitudes and ON⁽¹⁷⁾. Similarities between ON and established eating disorders, such as adapting one's lifestyle to suit eating patterns, over-concern about food and constructing one's identity based on diet, have been identified⁽⁴⁾. The relationship between ON and recognised eating disorders is complex. ON may represent a mechanism for past sufferers of eating disorders to retain control over their food intake, with a different justification for dietary restrictions⁽¹⁷⁾. Individuals who have recovered from an eating disorder may follow special diets (e.g. vegetarianism or veganism) to continue restricting their food intakes in a socially acceptable way⁽⁵⁷⁾. Similarly, orthorexic behaviour characterised by restricting intake to foods considered 'healthy' or 'pure' may be an excuse to control the amounts of food consumed that would otherwise worry healthcare professionals. An examination of the prevalence and progression of ON among patients suffering from AN and BN found that, although the eating disorder symptoms decreased after treatment, orthorexic tendencies increased⁽¹⁷⁾. It is possible that ON can be considered as a residual symptom of eating disorders or a coping behaviour to overcome AN symptoms, where patients shift their focus from food quantity to quality⁽⁵⁸⁾. Another possibility is that ON might result from cognitive-behavioural therapy that aims to change patients' perceptions of food as threatening to their body shape. Patients are encouraged to establish a pattern of regular eating⁽⁵⁹⁾. From this perspective, ON offers a

compromise; at the same time as perceiving eating as a 'body-protective' practice, patients can still maintain control over their eating patterns.

Dietary assessments

As with the psychometric measures, participants' dietary intakes varied. One of the defining features of ON is obsessive striving for a healthy diet⁽²⁾. However, few studies have examined the extent to which the ON diet could actually be considered healthy.

Em's dietary intake was characterised by lower than recommended intakes of energy, protein, fat, iron, calcium, vitamin B₁₂ and zinc. Her carbohydrate, fibre, vitamin A and C intakes exceeded recommendations. Previous studies comparing diets of vegans with omnivores similarly identified lower energy, protein, fat and calcium intakes and higher fibre intakes⁽⁶⁰⁾. Adherence to a vegan diet is not generally viewed as pathological. People who choose veganism cite various reasons, which include animal welfare, ecological reasons, culture, religion and health. On the one hand, studies report lower blood cholesterol levels, rates of cardiovascular disease, hypertension, obesity and diabetes mellitus among vegans compared to their omnivore counterparts⁽⁶⁰⁾. On the other hand, adherence to a vegan diet is associated with an increased risk of anaemia⁽⁶¹⁾ and osteoporosis⁽⁶²⁾. Furthermore, having any dietary restrictions, regardless of whether these are for ethical or weight reasons, was associated with more orthorexic behaviour compared to individuals with no restrictions⁽⁶³⁾. More recent evidence suggests that ON is associated with differing motivation for following a vegan diet⁽⁶⁴⁾. Namely, health, aesthetics and healing were associated with orthorexic tendencies, whereas animal welfare, politics and ecology were not.

There are some similarities between Em's and Ebou's nutrient intakes. Ebou's intake was characterised by lower than recommended energy, fat, iron, calcium, polyunsaturated fats, fibre, folate, vitamin A and zinc, whereas intakes of protein, vitamin B₁₂ and vitamin C were higher. Both avoided dairy products, albeit for different reasons (ethical versus physical symptoms post-consumption).

Rafaela's diet suggested a number of issues, with low intakes of energy, carbohydrates, fat, PUFA, fibre, iron, calcium, folate, vitamins C and A, and an intake of saturated fatty acids that exceeded recommendations. Her diet included a high intake of processed red meat (165 g day⁻¹ compared to the recommendation of <70 g day⁻¹) and an inadequate consumption of fruit and vegetables (1.38 portions). This indicates a discrepancy between a major feature of ON (striving for a healthy diet) and actual intake. A high intake of red and processed meat is a risk factor for bowel cancer and the

consumption of little, if any, processed meat and a minimum of five portions of fruit and vegetables daily is recommended⁽⁶⁵⁾. Indeed, despite the variations between individual diets, all participants' dietary intakes were characterised by inadequacies compared to recommendations (Table 3).

In this small sample of individuals with rigid and highly restrictive dietary intakes, there are a number of interesting observations. Eight of 10 participants displayed characteristics of ON using ORTO-15, whereas only one displayed features of disordered eating, using EAT-26. Most participants described usual intakes that failed to meet healthy eating guidance, despite a strong motivation for, and commitment to, pure and healthy diets. The conceptualisation of 'pure' and 'healthy' clearly differs greatly among individuals because no single pattern of restrictions was identified. Bratman⁽¹⁾ also found that definitions of a 'healthy eating behaviour' differed among those with ON. All of our participants described rigid diets with a lack of variation day-to-day. If true, long-term dietary health is a concern. Although discipline in relation to diet and activity is needed to achieve and maintain a healthy weight and adequate dietary intake, the level of self-discipline described by participants in this pilot exceeded what might be considered usual or desirable.

The present pilot study aimed to identify the type and nature of eating practices of a group with orthorexic tendencies, comparing intakes with dietary recommendations. The results obtained suggest that there is no single dietary pattern characteristic of those with possible orthorexic tendencies, nor can the patterns of restrictions adopted be described as healthy. Intakes described failed to meet dietary recommendations for several nutrients. Failure to meet nutritional guidelines is not exclusive to this sample and, according to the National Diet and Nutrition Survey rolling programme, many adults fail to meet the recommended daily amounts for several nutrients⁽⁶⁶⁾. However, the individuals in the present study claimed to adhere to a healthy diet. Similarly, psychological test results were characterised by disparity between individuals, illustrating the difficulties inherent in diagnosing this condition. This suggests that no single psychometric measure is sufficient and that identification of ON should include a range of diagnostic tools. The present study indicates that a positive diagnosis might include scoring within obsessive-compulsive eating pathology ranges and attaining a high score on a measure of perceived control.

The data for this research derive from a larger study aiming to explore all aspects of ON. Dietary intake and psychometric measures were recorded as part of in-depth qualitative interviews to obtain a holistic view of dietary restrictions, what they meant to individuals and aspects of their psychology. The findings suggest that this

approach is useful in helping to identify potential diagnostic elements of ON, as well as participants' reasons for their dietary choices. Understanding the context of dietary choice is an essential component of dietetic treatment, enabling tailored approaches. Our intention is to follow up the participants to gain a more comprehensive view of the dietary patterns associated with possible ON.

Although this pilot study offers a tantalising view of aspects of this elusive condition, a number of limitations were identified. Recruitment of participants to ON studies is challenging because there are no officially accepted diagnostic criteria for ON. The present study used the ORTO-15 questionnaire to assess ON symptoms. Despite being the most frequently used tool, it has been criticised for identifying cases of peculiar dieting as pathological and overestimating the prevalence of ON⁽³⁶⁾. In addition, its validity and reliability have been questioned⁽⁶⁷⁾. It has been suggested that using a lower cut-off point of 35 would result in an improvement⁽⁶⁸⁾; however, when we did so in the present study, the same eight individuals were identified as having possible orthorexic tendencies (Table 2).

Dietary intake was recorded using self-reported 24-h recalls, which are subject to misreporting^(69,70). Misreporting of food intake has been associated with dietary restraint and is more likely in women⁽⁷¹⁾. Because ON is characterised by strict dietary restrictions, it is very likely that our participants under-reported their food intakes, and so the macro- and micronutrient deficiencies observed may be overestimated. Dietary consumption is complex with potentially large seasonal and day-to-day variations. Intakes over 24-h give a limited overview of dietary patterns, particularly of micronutrient intakes. The individuals in the present study indicated high dietary rigidity with little variation in the foods consumed. Given the nature of the condition a decision was made to explore dietary intakes in the pilot study using the least invasive methods, in addition to self-reported weights and heights. However, in the longer-term follow up, we intend to explore diets in more detail with a more comprehensive dietary assessment method.

Of the other psychometric measures, OCD-I, SoC and EAT-26, similar to previous research^(15,17,18,19), identified that individuals with possible orthorexic tendencies also present eating behaviours indicative of pathology, high levels of perceived personal control and obsessive-compulsive tendencies. These measures will contribute to our understanding of ON in future work along with a reliable measure of ON. The MBSRQ and RSES scales did not identify issues with participants' self-esteem and body image, suggesting that motivations for adhering to a diet striving for 'health' may not be related to concerns about physical appearance and self-esteem. In future work, the use of the Teruel Orthorexia Scale⁽⁵⁵⁾ not only to identify individuals with orthorexic tendencies, but also to

distinguish between healthy and pathological dimensions of ON would be useful. Comparison of the dietary intakes of individuals identified as 'healthy ON' with those with a pathological score would be insightful.

In conclusion, this small pilot study demonstrates considerable heterogeneity between individuals scoring within or just over the cut-off points for identification of ON using the most frequently used diagnostic tool. No single pattern of dietary restrictions was identified that could flag up such individuals in practice; similarly, their psychometric measures demonstrated considerable variation. Of note, despite expressing a strong motivation for clean and healthy nutrition, the dietary intakes of participants did not represent a healthy diet. High levels of dietary restraint and excessive rigidity in terms of intake will always raise concerns. However, within the ON population, those with weight concerns may be a group of greater concern to healthcare professionals.

Conflict of interests, source of funding and authorship

The study received no external funding. The authors have no conflict of interest to declare. AP conceived and designed the study and oversaw the data collection, as well as the analysis and the writing of the paper. EM carried out the data collection and analysis and wrote the initial draft of the paper. HM contributed to the data analysis and the writing of the paper. All authors critically reviewed the manuscript and approved the final version submitted for publication.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with STROBE2 guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

Participant details

Participants were recruited in the UK.

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Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix S1. Qualitative exploration of the driving forces behind ‘qualitative attribute based’ food restriction practices in young adults.

Appendix 3

Information sheet

Title: Qualitative exploration of the driving forces behind 'qualitative attribute based' food restriction practices in young adults

Invitation: You are being invited to take part in this research. It is important that you understand what this study is about and what it will involve. Please read the information provided below before you make a decision to participate. Do not hesitate to ask as many questions regarding this project as you like. I will be happy to answer all your inquiries.

Aim: This project's aims are to develop a better understanding of people's relationship with their food choices, explore what is it that people actually eat, and investigate relationship with physical exercise.

Why I have been chosen? You have been invited to take part in this study because it is known that you are following a particular diet in your day-to-day life.

Do I have to take part? Participation in this project is voluntary. If you decide to participate you will be given this information sheet, asked to sign a consent form and to take part in audio-recorded interview followed by nutritional assessment and a number of questionnaires. You are free to withdraw from the study at any time, and you may do so without giving a reason. Once you've completed all the measures and the interview you may request to remove your data from this study in the first 30 days.

What will happen if you take part? You will be asked to participate in an interview that will be audio-recorded. The interview may be carried out face-to-face or via Skype. This will be arranged to suit your schedule. After the interview you will be asked to complete a nutritional measure and fill in a number of psychometric questionnaires. The whole process will take approximately 2 hours.

It is of utmost importance to receive the true information. All the collected data, therefore, will be anonymised.

Disadvantages and risks of taking part. There will be no other risks than those typically encountered when carrying out interviews and questionnaire assessments. The risks are minimised because all the data will be anonymised. Collected data will be stored on a password-protected computer.

The benefits of taking part. Your participation will help towards the understanding of reasons, beliefs, motives and feelings people develop towards food. It will help us understand why people choose to eat what they do and what consequences their choices have on their health, relationships with others and lifestyle. In addition, you might gain a new perspective and better understanding of your own experiences through the data collection process.

Can I change my mind after I provide the information? You may withdraw from participation at any time. You may have your data removed after the data collection stage in the first 30 days. You don't need to justify your decision.

What happens if something goes wrong? Participation in this study does not involve any risks. If during or after the data collection you experience any discomfort caused by this study please notify the researcher right away.

Researcher's contact details can be found at the end of this information sheet. If during the research you became concerned about your diet and its potential effect on your health, you may consult a member of the research team, Dr Hilda Mulrooney, who is a registered dietitian, or your GP.

Who has reviewed this study? This study has been reviewed and approved by the FREC.

Confidentiality. All the information collected in the course of this project will be kept strictly confidential. All the hard copies will be kept under a lock at the Kingston University and all the recorded interviews and subsequent analysis will be kept on a password-protected computer. Access to the raw data will only be available to the research team. Parts of interviews will be used for publication in a scientific paper. However, all the data will be anonymous and will never lead to discovering participants' identities. The data will be kept for a minimum of 5 years and then will be destroyed via the confidential waste disposal system of Kingston University.

Contact for further information: If you have any questions or would like more information regarding the project, please do not hesitate to contact Elina Mitrofanova on k1558879@kingston.ac.uk or Professor Andrea Petroczi at Kingston University,
School of Life Sciences, Pharmacy and Chemistry
T: 0208417 2436

a.petroczi@kingston.ac.uk

Please keep this sheet for your records.

Thank you for agreeing to participate in this research!

Appendix 4

Information sheet.

You are invited to take part in a study about restrictive diets. Restrictive diets in this study are defined as forms of eating behaviour where individuals consume food based on self-defined set of rules that are not accounted for by observation of religious food-related rituals and medical intolerance. Whether or not you take part is entirely up to you. If you don't want to take a part, you don't have to give a reason and may withdraw at any time during the completion of questionnaires. Please note that you cannot withdraw your data after completing the survey because we cannot identify which data are yours.

Please read the following information that will help you decide if you'd like to take part.

The aim of this project is to develop a better understanding of underlying reasons behind restricted diets that people choose to follow in order to maximise own health. The following is a list of questions asking about your eating habits and food choices. We are interested to learn what your reasons, motivation, and feelings are for what you choose to eat.

Advantages, disadvantages and risks of taking part. There is no direct advantage to you but your participation contributes to our understanding of restrictive diets. There will be no other risks than those typically encountered when carrying out questionnaire assessment. The risks are minimised because all the data is anonymised. Collected data will be stored encrypted in a password protected computer.

What will my participation in the study involve. You will be provided with a link to the online survey. You will then be asked to answer a series of online questionnaires, which will take you approximately 20 minutes.

What happens if something goes wrong? Participation in this study does not involve any risks. If during the data collection you experience any discomfort caused by this study, please notify the researcher right away and contact your GP. Researchers' contact details can be found at the end of this information sheet.

Who has reviewed this study? This study has been reviewed and approved by the Faculty of Science, Engineering and Computing Ethics Research Committee of Kingston University.

Confidentiality. All the information collected in the course of this project will be kept strictly confidential. All collected data and subsequent analysis will be kept encrypted on a password protected computer. Access to the data will only be available to the research team. The data will be kept for a minimum of 5 years or longer if required by the journal in case of publication or the University's open data policy and then will be destroyed via the confidential waste disposal system of Kingston University.

Contact for further information: If you have any questions, please do not hesitate to contact Elina Mitrofanova on k1558879@kingston.ac.uk or Professor Andrea Petroczi at Kingston University, School of Life Sciences, Pharmacy and Chemistry. T: 02084172436. a.petroczi@kingston.ac.uk

Thank you for participating in this research!

QUESTIONNAIRE

Please answer the following questions as accurately, honestly and completely as possible. You can choose only one answer for each question. There are no right or wrong answers. We are interested in your reasons for and cognitions about your food-related choices. All your responses are confidential and anonymous.

By completing and submitting this questionnaire, you agree to participate.

Your participation is very important to us and we are grateful for your time.

1. What is your age (years and months)?

2. What gender do you identify with?

- ☐ Male
- ☐ Female
- ☐ Other, specify:
- ☐ I'd rather not say

3. What is your ethnic group? (Please choose only one).

White

- ☐ English
- ☐ Welsh
- ☐ Scottish
- ☐ Northern Irish
- ☐ British
- ☐ Irish
- ☐ Any other White background, please describe

Mixed / Multiple ethnic groups

- ☐ White and Black Caribbean
- ☐ White and Black African
- ☐ White and Asian
- ☐ Any other Mixed / Multiple ethnic background, please describe

Asian / Asian British

- ☐ Indian
- ☐ Pakistani
- ☐ Bangladeshi
- ☐ Chinese
- ☐ Any other Asian Background, please describe

Black / African / Caribbean / Black British

- ☐ African
- ☐ Caribbean
- ☐ Any other Black / African / Caribbean background, please describe

Other ethnic group

- ☐ Arab
- ☐ Any other ethnic group, please describe

4. What is your country of birth?

5. What is your country of residence?

6. What language do you speak at home?

7. What is your height in feet and inches?

Feet

Inches

Meters

Centimetres

8. What is your current weight in pounds or kilograms?

9. Do you consider yourself:

- ☐ Underweight
- ☐ Normal weight
- ☐ Overweight
- ☐ Obese

10. Do you have any restrictions in your daily diet?

- ☐ Yes
- ☐ No

If you answered no, please proceed to the next page.

11. If yes, what are they?

12. How long have you been following your diet? (Please provide a number of months in a box below).

Below are statements about your eating practices and aspirations. Please read each statement carefully and indicate your level of agreement with it. There is no right or wrong answer. We are interested in what you do. Some statement may seem repetitive. Please consider each carefully and answer honestly.

		Strongly disagree ①	Disagree ②	Slightly disagree ③	Slightly agree ④	Agree ⑤	Strongly agree ⑥
1	I spend a considerable amount of time preparing food.						
2	If I eat something outside of my diet, I will try to make up for it and eat less or exercise more the next day.	①	②	③	④	⑤	⑥
3	When I go on holiday I always make sure I can stick to my eating habits.	①	②	③	④	⑤	⑥
4	I try to convince others to follow my healthy eating habits.	①	②	③	④	⑤	⑥
5	I frequently seek information about nutrition (e.g. on the internet, reading books on nutrition).	①	②	③	④	⑤	⑥
6	If I don't find foods I approve of I'd rather not eat at all.	①	②	③	④	⑤	⑥
7	I have a strict exercise routine to complement my diet.	①	②	③	④	⑤	⑥
8	I make sure that I eat at the same time of day.	①	②	③	④	⑤	⑥
9	Healthy eating is a large part of who I am.	①	②	③	④	⑤	⑥
10	I carefully check the ingredients before I buy a food item.	①	②	③	④	⑤	⑥
11	My food choices are based on a desire to maximise my health.	①	②	③	④	⑤	⑥
12	It's difficult to find a restaurant that serves the foods that I eat.	①	②	③	④	⑤	⑥
13	I avoid genetically modified foods.	①	②	③	④	⑤	⑥
14	I think about healthy eating while doing something else.	①	②	③	④	⑤	⑥
15	I enjoy meeting people with similar eating habits to mine.	①	②	③	④	⑤	⑥
16	I feel a sense of achievement when I stick to my diet	①	②	③	④	⑤	⑥
17	My family has to make me a separate meal/dish when eating together (e.g. Christmas, Easter).	①	②	③	④	⑤	⑥

18	I follow my diet because I want people to like me.	①	②	③	④	⑤	⑥
19	I'm very specific about my food choices.	①	②	③	④	⑤	⑥
20	I eat only healthy food.	①	②	③	④	⑤	⑥
21	My body is pure because of my healthy diet.	①	②	③	④	⑤	⑥
22	My friends/family don't understand my eating habits.	①	②	③	④	⑤	⑥
23	I avoid processed foods.	①	②	③	④	⑤	⑥
24	I spend a lot of time researching nutritional composition of foods.	①	②	③	④	⑤	⑥
25	I don't restrict myself when it comes to food.	①	②	③	④	⑤	⑥
26	I regularly perform a cleanse (e.g. detox, fast).	①	②	③	④	⑤	⑥
27	I am what I eat.	①	②	③	④	⑤	⑥
28	My eating habits do not dictate my social life.	①	②	③	④	⑤	⑥
29	In the past year, my diet has become more complicated.	①	②	③	④	⑤	⑥
30	I avoid foods that were treated with pesticides.	①	②	③	④	⑤	⑥
31	I don't explore new/foreign foods.	①	②	③	④	⑤	⑥
32	If I'm not sure about the quality of food, I will not eat it.	①	②	③	④	⑤	⑥
33	I don't enjoy the company of people with unhealthy eating habits.	①	②	③	④	⑤	⑥
34	Other people have mentioned that my diet is too restrictive.	①	②	③	④	⑤	⑥
35	My food choices are based on my desire to maximise my fitness performance.	①	②	③	④	⑤	⑥
36	I plan my meals in advance.	①	②	③	④	⑤	⑥
37	My diet has more health benefits than other diets.	①	②	③	④	⑤	⑥
38	I am able to avoid straying off my diet even when I feel low.	①	②	③	④	⑤	⑥
39	If I wasn't eating the way I do, people wouldn't be interested in me.	①	②	③	④	⑤	⑥
40	I feel guilty if I miss a workout.	①	②	③	④	⑤	⑥
41	It's important for me to know where the food I buy at the supermarket/market comes from.	①	②	③	④	⑤	⑥
42	The availability of certain foods influences my choice of holiday destinations.	①	②	③	④	⑤	⑥

43	I don't trust the information provided on the food labels.	①	②	③	④	⑤	⑥
44	Nutrition is a hobby of mine.	①	②	③	④	⑤	⑥
45	The main function of food is to fuel my body.	①	②	③	④	⑤	⑥
46	I avoid food that I haven't prepared myself.	①	②	③	④	⑤	⑥
47	Some foods have medicinal properties.	①	②	③	④	⑤	⑥
48	I feel bad if I can't complete my workout plan for the day.	①	②	③	④	⑤	⑥
49	I feel guilty when I eat unhealthy food.	①	②	③	④	⑤	⑥
50	I eat healthy because I want to improve the way I look.	①	②	③	④	⑤	⑥
51	I actively seek the latest trends/information/news in nutrition.	①	②	③	④	⑤	⑥
52	My friends and family have similar eating habits.	①	②	③	④	⑤	⑥
53	I only buy brands I trust	①	②	③	④	⑤	⑥
54	My chosen diet has a direct impact on my appearance.	①	②	③	④	⑤	⑥
55	I bring my own food with me wherever I go.	①	②	③	④	⑤	⑥
56	I go out less frequently since I began eating healthy.	①	②	③	④	⑤	⑥
57	I try to keep my body as pure as possible.	①	②	③	④	⑤	⑥
58	I am happy to tell others about my eating habits.	①	②	③	④	⑤	⑥
59	I carefully monitor the nutritional composition of what I eat.	①	②	③	④	⑤	⑥
60	I try to eat only organic food.	①	②	③	④	⑤	⑥
61	I plan when to allow myself a treat outside of my diet.	①	②	③	④	⑤	⑥
62	Being able to stick to my diet has a positive impact on my mood.	①	②	③	④	⑤	⑥
63	I measure every portion.	①	②	③	④	⑤	⑥
64	I follow a very strict diet (e.g. vegetarian, vegan, frugivore).	①	②	③	④	⑤	⑥
65	The main motivation behind my food choices is weight management.	①	②	③	④	⑤	⑥
66	I make sure that my diet is better than most people's diet.	①	②	③	④	⑤	⑥
67	Most of my social interactions involve a discussion about my eating habits	①	②	③	④	⑤	⑥

68	I follow my diet in order not to gain weight.	①	②	③	④	⑤	⑥
69	My diet is designed to keep me at a specific weight.	①	②	③	④	⑤	⑥
70	I buy food products I know.	①	②	③	④	⑤	⑥
71	I try to convince others to follow my healthy eating habits.	①	②	③	④	⑤	⑥
72	Only certain foods are healthy for me to eat.	①	②	③	④	⑤	⑥
73	I would rather miss a social event than my workout session.	①	②	③	④	⑤	⑥
74	My diet has many rules.	①	②	③	④	⑤	⑥
75	I feel better about myself when I manage to avoid slipping off my healthy diet.	①	②	③	④	⑤	⑥
76	I can have any food as long as I consume it in moderation.	①	②	③	④	⑤	⑥
77	I don't eat certain foods because I believe they are bad for my skin.	①	②	③	④	⑤	⑥
78	I don't trust anyone to do food shopping for me.	①	②	③	④	⑤	⑥
79	I rarely allow myself a treat outside of my diet.	①	②	③	④	⑤	⑥
80	It's important for me to know where the food I buy comes from.	①	②	③	④	⑤	⑥
81	I'm accepting of other people's eating habits.	①	②	③	④	⑤	⑥

Below you will find a series of statements. Please read each statement carefully and respond by expressing whether the statement applies to you by ticking the box next to statement.

1. I spend so much time of my life thinking about, choosing and preparing healthy food that it interferes with other dimensions of my life, such as love, creativity, family, friendship, work, and school.

- ☐ True for me
- ☐ Not true for me

2. When I eat any food I regard to be unhealthy, I feel anxious, guilty, impure, unclean and/or defiled; even to be near such foods disturbs me, and I feel judgmental of others who eat such foods.

- ☐ True for me
- ☐ Not true for me

3. My personal sense of peace, happiness, joy, safety, and self-esteem are excessively dependent on the purity and rightness of what I eat.

- ☐ True for me
- ☐ Not true for me

4. Sometimes I would like to relax my self-imposed “good food” rules for a special occasion, such as a wedding or a meal with family or friends, but I find that I cannot. (Note: if you have a medical condition in which it is unsafe for you to make ANY exceptions to your diet, then this item does not apply.).

- ☐ True for me
- ☐ Not true for me

5. Over time, I have steadily eliminated more foods and expanded my list of food rules in an attempt to maintain or enhance health benefits; sometimes, I may take an existing food theory and add to it with beliefs of my own.

- ☐ True for me
- ☐ Not true for me

6. Following my theory of healthy eating has caused me to lose more weight than most people would say is good for me, or has caused other signs of malnutrition such as hair loss, loss of menstruation or skin problems.

- ☐ True for me
- ☐ Not true for me

Please answer the following questions as accurately, honestly and completely as possible. You can choose only one answer for each question. There are no right or wrong answers. All your responses are confidential and anonymous.

1. Have you ever been diagnosed with an eating disorder?

- ☐ Yes
- ☐ No

If yes, what was the diagnosis?

2. Have you ever been diagnosed with a form of obsessive-compulsive disorder (OCD)?

- ☐ Yes
- ☐ No

3. Do you have a known medical or psychological condition that impacts upon your food choices and dietary behaviour?

- ☐ Yes
- ☐ No

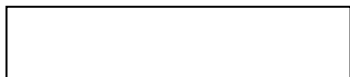
If yes, what is the condition?

4. Please use the space below to tell us more about the way the medical/psychological condition impacts your food choices and dietary behaviour.

5. Are you following any religious diets?

- ☐ Yes
- ☐ No

6. If yes, which one?



Appendix 5

Table 4.2

Items and factor loadings of the first iteration of EFA.

[illegible]

Table 4.2. Continued.

Items and factor loadings of the first iteration of EFA.

[illegible]

Table 4.2. Continued.*Items and factor loadings of the first iteration of EFA.*

Items	Component																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Most of my social interactions involve a discussion about my eating habits											.419									
I plan when to allow myself a treat outside of my diet											.355									
Only certain foods are healthy for me to eat												.553								
My friends/family don't understand my eating habits												.379								
I go out less frequently since I began eating healthy												.318								
I'm accepting of other people's eating habits													.768							

Table 4.2. Continued.*Items and factor loadings of the first iteration of EFA.*

Items	Component																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I can have any food as long as I consume it in moderation													.429							
I don't enjoy the company of people with unhealthy eating habits								.348						-.396						
The main function of food is to fuel my body														.708						
I buy food products I know														.397		-.356				
My eating habits do not dictate my social life															.748					
I don't restrict myself when it comes to food										.308				.383	.505					
I am able to avoid straying off my diet even when I feel low												-.307			.344					

Appendix 6

Information sheet.

You are invited to take part in a study about healthy eating habits. Restrictive diets in this study are defined as forms of eating behaviour where individuals consume food based on self-defined set of rules that are not accounted for by observation of religious food-related rituals and medical intolerances. Whether or not you take part is entirely up to you. If you don't want to take a part, you don't have to give a reason and may withdraw at any time during the completion of questionnaires. Please note that you cannot withdraw your data after completing the survey because we cannot identify which data are yours.

Please read the following information that will help you decide if you'd like to take part.

The aim of this project is to develop a better understanding of underlying reasons behind restricted diets that people follow in order to maximise own health. The following is a list of questions asking about your eating habits and food choices. We are interested to learn what your reasons, motivation, and feelings are for what you choose to eat.

Advantages, disadvantages and risks of taking part. There is no direct advantage to you, but your participation contributes to our understanding of restrictive diets. There will be no other risks than those typically encountered when carrying out questionnaire assessment. The risks are minimised because all the data is anonymised. Collected data will be stored encrypted in a password protected computer.

What will my participation in the study involve? You will be provided with a link to the online survey or given a paper/pencil form. You will then be asked to answer a series of online or paper questionnaires, which will take you approximately 20 minutes.

What happens if something goes wrong? Participation in this study does not involve any risks. If during the data collection you experience any discomfort caused by this study, please notify the researcher right away and contact your GP. Researchers' contact details can be found at the end of this information sheet.

Who has reviewed this study? This study has been reviewed and approved by the Faculty of Science, Engineering and Computing Research Ethics Committee of Kingston University.

Confidentiality. All the information collected in the course of this project will be kept strictly confidential. All collected data and subsequent analysis will be kept encrypted on a password protected computer. Access to the data will only be available to the research team. The data will be kept for a minimum of 5 years or longer if required by the journal in case of publication or the University's open data policy and then will be destroyed via the confidential waste disposal system of Kingston University.

Contact for further information: If you have any questions, please do not hesitate to contact Elina Mitrofanova on k1558879@kingston.ac.uk or Professor Andrea Petroczi at Kingston University, School of Life Sciences, Pharmacy and Chemistry. T: 02084172436. a.petroczi@kingston.ac.uk

Thank you for participating in this research!

QUESTIONNAIRE

Please answer the following questions as accurately, honestly and completely as possible. You can choose only one answer for each question. There are no right or wrong answers. We are interested in what you do. All your responses are confidential and anonymous.

By completing and submitting this questionnaire, you agree to participate.

Your participation is very important to us and we are grateful for your time.

1. What is your age (years and months)?

2. What gender do you identify with?

- ☐ Male
- ☐ Female
- ☐ Other, specify:
- ☐ I'd rather not say

3. What is your ethnic group? (Please choose only one).

White

- ☐ English
- ☐ Welsh
- ☐ Scottish
- ☐ Northern Irish
- ☐ British
- ☐ Irish
- ☐ Any other White background, please describe

Mixed / Multiple ethnic groups

- ☐ White and Black Caribbean
- ☐ White and Black African
- ☐ White and Asian

☐ Any other Mixed / Multiple ethnic background,
please describe

Asian / Asian British

- ☐ Indian
- ☐ Pakistani
- ☐ Bangladeshi
- ☐ Chinese

☐ Any other Asian Background, please describe

Black / African / Caribbean / Black British

- ☐ African
- ☐ Caribbean

☐ Any other Black / African / Caribbean background,
please describe

Other ethnic group

- ☐ Arab

☐ Any other ethnic group, please describe

4. What is your country of birth?

5. What is your country of residence?

6. What language do you speak at home?

7. What is your height in feet and inches or in meters and centimeters?

Feet

Inches

Meters

Centimetres

8. What is your current weight in pounds or kilograms?

9. Do you consider yourself:

- ☐ Underweight
- ☐ Normal weight
- ☐ Overweight
- ☐ Obese

10. Do you have any restrictions in your daily diet?

- ☐ Yes
- ☐ No

If you answered no, please proceed to the next page.

11. If yes, what are they?

12. How long have you been following your diet? (Please provide a number of months in a box below).

Below are statements about your eating practices and aspirations. Please read each statement carefully and indicate your level of agreement with it. There is no right or wrong answer. We are interested in what you do. Some statement may seem repetitive. Please consider each carefully and answer honestly.

		Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
		①	②	③	④	⑤	⑥
1	My diet has more health benefits than other diets.	①	②	③	④	⑤	⑥
2	Healthy eating is a large part of who I am.	①	②	③	④	⑤	⑥
3	I eat only healthy food.	①	②	③	④	⑤	⑥
4	My body is pure because of my healthy diet.	①	②	③	④	⑤	⑥
5	I have a strict exercise routine to compliment my diet.	①	②	③	④	⑤	⑥
6	I feel a sense of achievement when is tick to my diet.	①	②	③	④	⑤	⑥
7	Being able to stick to my diet has a positive impact on my mood.	①	②	③	④	⑤	⑥
8	I feel better about myself when I manage to avoid slipping off my diet.	①	②	③	④	⑤	⑥
9	My chosen diet has a direct impact on my appearance.	①	②	③	④	⑤	⑥
10	I eat healthy because I want to improve the way I look.	①	②	③	④	⑤	⑥
11	My diet is good for my skin.	①	②	③	④	⑤	⑥
12	It's difficult to find a restaurant that serves the foods that I eat.	①	②	③	④	⑤	⑥
13	My family has to make me a separate meal/dish when eating together (e.g. Christmas, Easter).	①	②	③	④	⑤	⑥
14	Other people have mentioned that my diet is too restrictive.	①	②	③	④	⑤	⑥
15	My diet has many rules.	①	②	③	④	⑤	⑥
16	I avoid food that I haven't prepared myself.	①	②	③	④	⑤	⑥
17	I'm very specific about my food choices.	①	②	③	④	⑤	⑥
18	I follow my diet in order not to gain weight.	①	②	③	④	⑤	⑥

19	My diet is designed to keep me at a specific weight.	①	②	③	④	⑤	⑥
20	The main motivation behind my food choices is weight management.	①	②	③	④	⑤	⑥
21	If I eat something outside of my diet, I will try to make up for it and eat less or exercise more the next day.	①	②	③	④	⑤	⑥
22	I avoid foods that were treated with pesticides.	①	②	③	④	⑤	⑥
23	I avoid genetically modified foods.	①	②	③	④	⑤	⑥
24	I avoid processed foods.	①	②	③	④	⑤	⑥
25	It's important for me to know where the food I buy at the supermarket/market comes from.	①	②	③	④	⑤	⑥
26	Most of my social interactions involve a discussion about my eating habits.	①	②	③	④	⑤	⑥
27	Nutrition is a hobby of mine.	①	②	③	④	⑤	⑥
28	I make sure that my diet is better than most people's diet.	①	②	③	④	⑤	⑥
29	I actively seek the latest trends/information/news in nutrition.	①	②	③	④	⑤	⑥
30	I spend a lot of time researching nutritional composition of foods.	①	②	③	④	⑤	⑥
31	I plan when to allow myself a treat outside of my diet.	①	②	③	④	⑤	⑥
32	I measure every portion.	①	②	③	④	⑤	⑥
33	I carefully monitor the nutritional composition of what I eat.	①	②	③	④	⑤	⑥
34	All my meals are planned.	①	②	③	④	⑤	⑥
35	I calculate the calories of each meal I allow myself.	①	②	③	④	⑤	⑥

Below you will find a series of statements. Please read each statement carefully and respond by expressing whether the statement applies to you by ticking the box next to statement.

1. I spend so much time of my life thinking about, choosing and preparing healthy food that it interferes with other dimensions of my life, such as love, creativity, family, friendship, work, and school.

- ☐ True for me
- ☐ Not true for me

2. When I eat any food I regard to be unhealthy, I feel anxious, guilty, impure, unclean and/or defiled; even to be near such foods disturbs me, and I feel judgmental of others who eat such foods.

- ☐ True for me
- ☐ Not true for me

3. My personal sense of peace, happiness, joy, safety, and self-esteem is excessively dependent on the purity and rightness of what I eat.

- ☐ True for me
- ☐ Not true for me

4. Sometimes I would like to relax my self-imposed “good food” rules for a special occasion, such as a wedding or a meal with family or friends, but I find that I cannot. (Note: if you have a medical condition in which it is unsafe for you to make ANY exceptions to your diet, then this item does not apply.).

- ☐ True for me
- ☐ Not true for me

5. Over time, I have steadily eliminated more foods and expanded my list of food rules in an attempt to maintain or enhance health benefits; sometimes, I may take an existing food theory and add to it with beliefs of my own.

- ☐ True for me
- ☐ Not true for me

6. Following my theory of healthy eating has caused me to lose more weight than most people would say is good for me, or has caused other signs of malnutrition such as hair loss, loss of menstruation or skin problems.

- ☐ True for me
- ☐ Not true for me

Please answer the following questions as accurately, honestly and completely as possible. You can choose only one answer for each question. There are no right or wrong answers. All your responses are confidential and anonymous.

1. Have you ever been diagnosed with an eating disorder?

- ☐ Yes
- ☐ No

If yes, what was the diagnosis?

2. Have you ever been diagnosed with a form of obsessive-compulsive disorder (OCD)?

- ☐ Yes
- ☐ No

3. Do you have a known medical or psychological condition that impacts upon your food choices and dietary behaviour?

- ☐ Yes
- ☐ No

If yes, what is the condition?

4. Please use the space below to tell us more about the way the medical/psychological condition impacts your food choices and dietary behaviour.

5. Are you following any religious diets?

- ☐ Yes
- ☐ No

6. If yes, which one?

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